ACIL ALLEN

June 2022

Report to NSW Department of Planning and Environment

NSW Bushfire Risk Management Research Hub evaluation

Final Report

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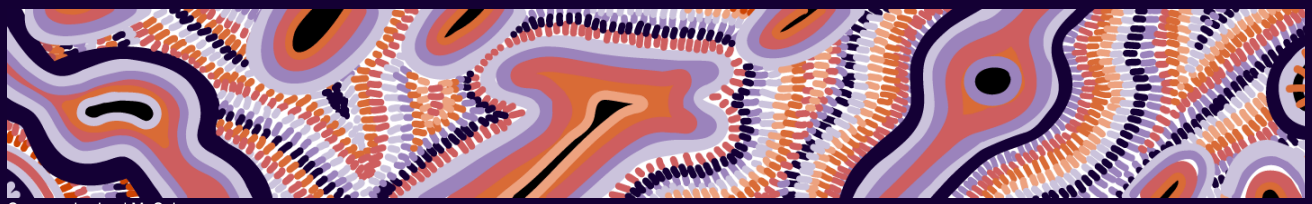
Our vision is to be Australia's most trusted economics, policy and strategy advisory firm. We are committed and passionate about providing rigorous independent advice that contributes to a better world.

ACIL Allen acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of the land and its waters. We pay our respects to Elders, past and present, and to the youth, for the future. We extend this to all Aboriginal and Torres Strait Islander peoples reading this report.



Goomup, by Jarni McGuire

Glossary

ARC	Australian Research Council
Bushfire and Natural Hazards CRC	Bushfire and Natural Hazards Cooperative Research Centre
CCF	Climate Change Fund
CERMB	Centre for Environmental Risk Management of Bushfires
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EBMP	Enhanced Bushfire Management Program
EPA	Environment Protection Agency
FTE	Full time equivalent (staff resourcing measure)
GHG	Greenhouse Gas
KEQs	Key Evaluation Questions
KPI	Key Performance Indicator
NHMRC	National Health and Medical Research Council
NSW	New South Wales
OEH	Office of Environment and Heritage
RFT	Request for Tender
The Department	Department of Planning and Environment
The Hub	The NSW Bushfire Risk Management Research Hub
UNSW	University of New South Wales
UOW	University of Wollongong
UTAS	University of Tasmania
WG	Working Group
Williams Review	Review of NSW Office of Environment and Heritage investment in bushfire research
WP	Work Package
WSU	Western Sydney University

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NSW Bushfire Risk Management Research Hub
EVALUATION OVERVIEW AND FINDINGS

About the Hub

Collaborative research comprising researchers, fire agencies, public land managers and Indigenous knowledge holders aiming to improve understanding of bushfire behaviour and risk.

2018 to 2022

6 work packages

$5.0 million funding

CORE HUB PARTNERS

NSW Government Planning & Environment; University of Wollongong Australia; UNSW Sydney; University of Tasmania; Western Sydney University

Guiding Principles

- Enhance bushfire research (strategic knowledge & fire management)
- Deliver a cost-effective research program & leverage investment
- Deliver evidence-based research for end users
- Transfer and integrate skills and knowledge

End users

- Department of Planning and Environment
- Rural Fire Service
- National Parks and Wildlife Service
- Ministry of Health
- NSW EPA
- Crown Lands
- Indigenous communities

Key benefits

- Achieved critical mass of bushfire research
- Strengthened partnerships between fire researchers and fire management
- Legacy of continued activities, tools and impacts

Primary impacts / outputs

- Evidence for the NSW Bushfire **Inquiry** (19 projects)
- Impacted and influenced **burning strategies** (e.g. FireTools)
- Contributed to **cultural burning research**
- **241 outputs** (e.g. 27% newspaper articles, 20% publications, 18% articles & theses)
- **$16.69 million** leveraged funding ($3.34 return per $1 invested)

NSW Bushfire Risk Management Research Hub

The evaluation scope was to assess the how well the Hub met its guiding principles, analyse the efficiency and effectiveness of governance and implementation and identify lessons learnt and recommendations for future programs.

THINGS DONE WELL

- Established a clear purpose and focus to the research
- Facilitated collaboration and coordination
- Created value for stakeholders
- Achieved good value for money – $16.69 million leveraged funding ($3.34 return on every $1)
- Delivered a wide range of outputs for varied end users

THINGS TO KEEP DOING

- Use similar approaches to coordinate research, develop tools and apply research
- Collaborate across universities, research, government and communities
- Engage end users and transfer knowledge and fund a dedicated knowledge management function to facilitate relationships

THINGS TO IMPROVE

- Better apply the Hub's research by investing in knowledge transfer and exchange and adequately resourcing and integrating end users
- Improve the performance and accountability architecture
- Better plan for and mitigate risks
- Engage and apply the learnings beyond NPWS and RFS

1 Introduction

1.1 Context

Climate change is having increasingly profound impacts on the environment and economy of Australia and the world. It presents many challenges to human safety and the well-being of communities, both locally and globally.

State and territory governments play a key role in driving climate change adaptation. The New South Wales (NSW) Government's Climate Change Policy Framework (the Framework) outlines the Government's commitment to effective action on climate change.[3] The Framework identifies the long-term objectives of achieving net-zero emissions by 2050 and making NSW more resilient to climate change. It aims to maximise the economic, social, and environmental well-being of NSW in the context of a changing climate.

The Climate Change Fund (CCF) supports the Framework's implementation. The CCF is investing $1.4 billion over 5 years to support activities that reduce greenhouse gas (GHG) emissions, reduce the impacts of climate change, raise public awareness about climate change and stimulate investment in innovative energy savings measures. A priority of the CCF's Strategic Plan (2017-22) is to build the capacity of land management agencies to enhance bushfire management.[1] It highlights hazard reduction as part of the NSW Government's overall bushfire mitigation strategy.

The 2019-20 bushfire season was extreme, with bushfires on a scale not seen in Australia's recorded history.[2] The season was characterised by increasingly severe fires, longer fire seasons (moving into autumn and winter) and larger areas of land affected by fires.[3] The experiences of that season showed the damage megafires can do and how devastating they can be to both humans (communities and firefighters) and the natural environment. While many factors contributed to the outcome, the 2020 NSW Government's Final Report of the NSW Bushfire Inquiry (the Inquiry) argued that climate change played an important role in the conditions that led to megafires:

> *"Climate change as a result of increased greenhouse gas emissions clearly played a role in the conditions that led up to the fires and in the unrelenting conditions that supported the fires to spread".*[4]

[1] NSW Government (2020). *Climate Change Fund Draft Strategic Plan 2017 to 2022*. Sydney: NSW Government.

[2] For example, the number of fire generated thunderstorms in south-eastern Australia since the early 1980s increased by almost 50 per cent in one bush fire season.

[3] Cook, G., Dowdy, D., Knauer, J., Meyer, M., Canadell, P. & Briggs P. (2021). *Australia's Black Summer of fire was not normal – and we can prove it*. Accessed 31 March 2022: https://blog.csiro.au/bushfires-linked-climate-change/.

[4] NSW Government (2020). *Final Report of the NSW Bushfire Inquiry*. Sydney: NSW Government.

Adapting to an increase in bushfire frequency and severity is a significant climate-induced challenge for NSW and much of Australia.

1.2 The Bushfire Risk Management Research Hub

1.2.1 Origins and guiding principles

The Department of Planning and Environment (the Department), and its agencies, such as the National Parks and Wildlife Service (NPWS), have statutory land management responsibilities for bushfires in NSW under the *Rural Fires Act 1997*.[5] In the context of bushfires, the Department is expected to:[6]

> *"… reduce or mitigate the risk from bushfire to life, property, and cultural and natural heritage."*

The Department funds bushfire research to deliver on its responsibilities under the Act. Research is funded internally, through Departmental fire science researchers, and externally, through Department-funded research in collaboration with external organisations. Before 2017, investment in bushfire research occurred through a co-investment model with the University of Wollongong's (UOW) Centre for Environmental Risk Management of Bushfires (CERMB). Between 2002 and 2017, the NSW Government invested $3.25 million in CERMB.

In 2017, the former NSW Office of Environment and Heritage (OEH) commissioned Dr Richard J (Dick) Williams to conduct a review of OEH's bushfire research investments (the Williams Review).[7] The Williams Review explored how the investment in research generated knowledge to support OEH's management objectives and research priorities aligned with the Living with Fire in NSW National Parks Strategy (Living with Fire Strategy).[8] It found that OEH's investment had been essential in supporting research partnerships and delivering research that effectively and efficiently supported policy and research priorities. To meet the Government's fire management and knowledge objectives, Williams recommended continuing bushfire research funding via co-investment with the UOW researcher partners.

The Department accepted Williams' recommendations and established the Bushfire Risk Management Research Hub (the Hub) in 2018 through a competitive tendering process. The Hub was a five-year initiative to develop end user-focused research to address knowledge gaps and the increasing complexity of bushfire management.

The Hub's research was designed to meet the Department's strategic knowledge needs and align with the objectives of the Department's Enhanced Bushfire Management Program (EBMP)[9] and the Living with Fire Strategy.

The Hub was established under four guiding principles, which provide the parameters for its activities, outputs and impacts (see Box 1.1).

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[5] Office of Environment and Heritage and NSW National Parks and Wildlife Service (2012). *Living with Fire in NSW National Parks: A strategy for managing bushfires in national parks and reserves 2012–2021*. Sydney: NSW Government.

[6] Office of Environment and Heritage (2017). *Request for Tender Part A AND B: Tendering Conditions and Statement of Requirements: Enhanced Bushfire Research Hub RFT Number: tender_880*. Sydney: NSW Government.

[7] Williams, R.J. (2017). *Review of NSW Office of Environment and Heritage investment in bushfire research*.

[8] Office of Environment and Heritage and NSW National Parks and Wildlife Service (2012). Op. cit.

[9] NSW Government (2021). *Enhanced Bushfire Management Program*. Accessed 31 March 2022: https://www.environment.nsw.gov.au/topics/fire/managing-fire/bushfire-management-program.

The Hub aims to develop new knowledge to underpin cost-effective strategies to improve fire management and reduce the risk fire poses to people, property and the environment. It seeks to guide the effective communication and dissemination of knowledge to the people who need it most.[10]

Box 1.1 Hub guiding principles

The principles are as follows:

- Enhance bushfire research that informs the Department's strategic knowledge needs and helps the Department to improve fire management
- Work closely with the Department to deliver a cost-effective research program which leverages greater investment for fire research
- Ensure research information is relevant, based on the best available evidence and readily available in forms that end users can access, easily understand and use
- Foster transfer and integration of skills and knowledge to the Department and also between research institutions, government agencies, Aboriginal co-management partners and the communities that the Department serves.

Source: Office of Environment and Heritage (2017b). Evaluation Plan - Bushfire Risk Management Research Hub. Sydney: NSW Government.

1.2.2 Participants

The Hub is a state-focused collaboration between the NSW Government, research institutions, fire management agencies, bushfire experts and Indigenous knowledge holders. The Hub is hosted by the UOW, with key Hub partners including the University of Tasmania (UTAS), University of New South Wales (UNSW) and Western Sydney University (WSU).

The Hub brings together researchers, fire agencies, policy makers, and public land managers in a collaborative research effort. The key Hub stakeholders are overviewed in Appendix.

1.2.3 Funding

The Hub has been funded under the CCF for five years, from February 2018 to June 2022. While most activities will be finalised by mid-2022, some are not planned to be completed before December 2022.

The total Hub funding of $5 million is allocated in two parts: $4 million for research funding, and $1 million for the Knowledge Exchange Officer position and activities. The Hub's research has been organised across six major project areas - work packages (WPs). DPE and NPWS provide oversight of the Hub and its budget.

The contract for the Hub was signed between the Department and the UOW as the host organisation. The UOW has partnership agreements with the partner universities. The Department makes payments to the UOW, which then distributes funding to the partner universities.

1.2.4 Governance and administrative arrangements

The Science Division of the Department initially administered the Hub. The Director of Ecosystem Management Science is responsible for the Hub in partnership with a Hub Steering Committee (Hub Steering Committee), the UOW and UTAS, WSU, and UNSW. This is now with the Science Economics and Insights Division in the Director of the Conservation and Restoration Branch.

[10] These people include policy makers, operational planners, on-ground fire services crews that work to mitigate fire risk, and the broader community (particularly those living on the fringes of cities).

The **Hub Steering Committee** is responsible for advising on the Hub's establishment, monitoring delivery, performance and setting/maintaining the direction.[11] It includes participants from the Department (i.e. divisions related to science, fire policy and management and the CCF), NPWS, NSW Rural Fire Service (RFS), the Ministry of Health, the Hub Director and independent experts from the University of New England, CSIRO and Charles Darwin University, and experts in air quality and human health, science, knowledge transfer and Aboriginal cultural heritage. The Hub Steering Committee **Chair** coordinates with the knowledge exchange officer the WPs and reporting to the Hub Steering Committee.

Dedicated **Working Groups** are responsible for the business issues associated with each WP, including providing feedback on work plans and outcomes, monitoring achievement of milestones and deliverables, and monitoring risks, quality and timeliness.

Dedicated WP **Researchers** are responsible for designing and conducting research. They work with end users through the Working Group and report their progress to Working Groups and Hub Steering Committee.

A **Secretariat and Knowledge Exchange Officer** is responsible for the Hub's administration, knowledge management activities and supporting the Steering Committee and Working Groups.

Promoters promote the communications from the Hub, such as government agencies, research organisations, industry or community members.

Hub **end users** are individuals or groups set to benefit from or use the Hub's outputs. They include government agencies, research organisations, industry or community members.

The Hub's governance and management model is analysed in chapter 3 and further described in Appendix A**.**

1.2.5 Work packages

The Hub's research has been organised across six major project areas. Further detail on the specific aims and methodology of each WP are available in Appendix A.2.

Table 1.1 Work Package descriptions

Work package	Aim
WP1 "**Dynamic Mapping of Fire Regimes, Past, Present, and Future**"	Transform pyrogeographic research and fire management capabilities by providing the first sub-continental scale understanding of the biophysical drivers of fires and the emergence of fire regimes.[12]
WP2 "**Fuel, Flammability, and Carbon Dynamics**"	Understand and provide fire managers with the tools to predict fuel type, quantity, and moisture content across NSW's landscape.[13]
WP3 "**Greenhouse Gasses, Particulate Emissions, and Air Quality**"	Understand the impact of planned burning on GHG emissions, air quality, and public health to define planned burning strategies to reduce overall exposure to smoke and GHG emissions.[14]

[11] Office of Environment and Heritage (2017). *Bushfire Research Hub Steering Committee Terms of Reference - V1.2*. Sydney: NSW Government.

[12] NSW Bushfire Risk Management Research Hub (2021). *Dynamic mapping of fire regimes, past, present, and future*. Accessed 23 Feb 2022: https://www.bushfirehub.org/work-packages/work-package-1-predicting-fire-regime-intensity/.

[13] NSW Bushfire Risk Management Research Hub (2021). *Fuel, Flammability, and Carbon Dynamics*. Accessed 1 Mar 2022: https://www.bushfirehub.org/work-packages/fuel-flammability-and-carbon-dynamics/.

[14] NSW Government Office of Environment and Heritage (2017). *WP3 Project Plan Proposal*.

Work package	Aim
WP4 "**Fire Regime Guidelines for Conservation of Threatened Species**"	Address fire management knowledge gaps to protect plant and animal biodiversity from fire regime threats and changes in fire regimes.[15]
WP5 "**Health and Social Benefits of Indigenous Fire Management Programs**"	Understand how cultural engagement links to well-being and resilience in fire and land knowledge and management to develop a case for expanding and coordinating Indigenous fire management practices.[16]
WP6 "**Optimisation of Cost-Effective Bushfire Risk Mitigation**"	Integrate the results from all other WPs to identify optimal solutions for cost-effective planned burning that builds on existing knowledge and supports adaptation to future human and climatic changes.[17]

Source: ACIL Allen, various sources

1.3 Evaluation scope and approach

1.3.1 Scope

In January 2022, the Department engaged ACIL Allen to undertake an independent evaluation of the Hub.

All programs funded through CCF are reviewed to ensure they align with requirements and provide appropriate, efficient and effective outcomes.

The scope of the evaluation requires ACIL Allen to:

— assess the how well the Hub met its guiding principles

— analyse efficiency and effectiveness of governance and implementation

— identify lessons learnt and recommendations for future programs.

The scope also requires ACIL Allen to address the Key Evaluation Questions (KEQs) outlined in Box 1.2 and detailed in the Hub's evaluation framework in Appendix A.3.

[15] NSW Bushfire Risk Management Research Hub (2021). *Fire Regime Guidelines for Conservation of Threatened Species*. Accessed 1 Mar 2022: https://www.bushfirehub.org/work-packages/fire-seasons-severity-and-biodiversity/.

[16] NSW Bushfire Risk Management Research Hub (2021). *Indigenous Cultural Burning: Exploring the Links Between Cultural Revitalisation and Wellbeing*. Accessed 1 Mar 2022: https://www.bushfirehub.org/work-packages/health-and-social-benefits-of-aboriginal-cultural-burning/.

[17] NSW Bushfire Risk Management Research Hub (2021). *Optimising Cost-Effective Bushfire Risk Mitigation Via Panned Burning*. Accessed 1 Mar 2022: https://www.bushfirehub.org/work-packages/understanding-indigenous-fire-management/.

Box 1.2 Key Evaluation Questions

Appropriateness

— A.1 To what extent is the program relevant to evolving NSW needs and priorities?

— A.2 To what extent was there effective co design and co-delivery with end users?

— A.3 How appropriate were the knowledge delivery mechanisms?

Effectiveness

— B.1 To what extent were program outputs accessed and used by target end users?

— B.2 To what extent were program outputs produced in the right form and in a timely fashion?

— B.3 How could the program be more effective in achieving its results?

Impacts

— C.1 To what extent are policies and planning requirements informed by information, knowledge and tools produced?

— C.2 To what extent has the information been used by end users outside the original target group?

— C.3 To what extent has the program achieved positive changes in the environment

Efficiency

— D.1 To what extent has the program been able to leverage additional resources (cash and in-kind contributions)?

— D.2 To what extent were partnerships / linkages between institutions / organisations encouraged and supported? Which partnerships / linkages were established? Which partnerships / linkages can be considered sustainable? Were they useful in addressing issues of overlap / duplication?

Legacy

— E.1 To what extent are the produced outputs / services likely to continue after the program timeline?

— E.2 Is there evidence that program partners / beneficiaries will continue their activities beyond program support?

— E.3 To what degree is there local ownership of program results?

Equity

— F.1 To what extent do the program targets treat vulnerable communities, sectors and regions equitably?

— F.2 To what extent have regional issues been considered in identifying risks and opportunities, and developing tools?

— F.3 To what extent has the program targeted high-climate-risk areas and -communities?

Source: OEH Evaluation Plan - Bushfire Risk Management Research Hub (2017)

The outcomes of this evaluation report will be used to inform future potential funding of related research.

1.3.2 Approach

This evaluation was undertaken using best practice techniques consistent with the Government's outcome-focused evaluation requirements and commonly used program evaluation approaches.

The evaluation was undertaken over several phases, culminating in the delivery of this report. The phases involved:

— Project inception and planning.

— Data collection and review, including a review of:

  – background information on the Hub, including the CCF Evaluation Framework (including the program logic, see Appendix A.4) and initial planning documentation (e.g. prospectus, evaluation plan)

  - foundational documents outlining the Hub's governance, funding and administrative arrangements
  - program data and reporting, including project plans, research outputs, progress reporting and reviews, survey reports, financial and progress reports, meeting minutes, monitoring activities and data developed by the Department
  - publicly available literature published by the Hub or referencing Hub information or projects.
- Consultation with key stakeholders (see Appendix B for a list of stakeholders consulted and the questions they were asked to consider).
- Analysis of the data collected against the Hub's guiding principles and the evaluation's KEQs.
- Reporting and presentations, including presentations to the Hub Steering Committee and Hub Evaluation Committee.

Data limitations

Some data limitations were encountered during the evaluation. These are reported throughout the document, where appropriate and include:

- The outcomes and impacts of the Hub lag the completion research. As such it is too soon to observe the most longer term changes occurring as a result of the Hub. The report focuses on outputs, outcomes and impacts observed to date and likely to occur soon.
- Reporting on KPIs and outcomes and impacts is limited. WPs and the Hub do not consistently and comprehensively report on KPIs, and reporting is often focused on activities and outputs, rather than outcomes and impacts.

1.4 This report

The report addresses the evaluation questions identified in the Hub evaluation plan (see Appendix A). In doing so, it assumes some prior knowledge of the Hub and associated NSW Government policies and programs.

The structure of the report and the evaluation questions addressed in each chapter is provided in Table 1.2.

Table 1.2 Evaluation questions addressed by each report chapter

Report chapter	Evaluation questions addressed
Chapter 2: The Hub's policy rationale and design	– A.1 To what extent is the program relevant to NSW needs and priorities?
Chapter 3: Governance, management, monitoring and evaluation	– E.3 To what degree is there local ownership of program results? – B.3 How could the program be more effective in achieving its results?
Chapter 4: WP design and planning	– A.2 To what extent was there effective co-design and co-delivery with end users? – F.1 To what extent do the program targets treat vulnerable communities, sectors and regions equitably? – F.2 To what extent have regional issues been considered in identifying risks and opportunities, and developing tools? – F.3 To what extent has the program targeted high-climate-risk areas and communities?

Report chapter	Evaluation questions addressed
Chapter 5: Delivery of the Hub	– B.1 To what extent were program outputs accessed and used by target end users? – B.2 To what extent were program outputs produced in the right form and in a timely fashion? – D.2 To what extent were partnerships/linkages between institutions/organisations encouraged and supported? Which partnerships/linkages were established? Which partnerships/linkages can be considered sustainable? – A.3 How appropriate were the knowledge delivery mechanisms?
Chapter 6: Impact of the Hub	– C.1 To what extent are policies and planning requirements informed by information, knowledge and tools produced? – C.2 To what extent has the information been used by end users outside the original target group? – C.3 To what extent has the program achieved positive changes in the environment? – D.1 To what extent has the program been able to leverage additional resources (cash and in-kind contributions)? – E.1 To what extent are the produced outputs/services likely to continue after the program timeline? – E.2 Is there evidence that program partners/beneficiaries will continue their activities beyond program support?
Appendix A: Supporting information	
Appendix B: Stakeholder engagement	

Source: ACIL Allen

The Hub's policy rationale and design 2

Good practice policy and program design dictate that government intervention should address a need or gap not currently addressed by other interventions or that cannot be delivered directly by the market. To this end, this chapter considers the underlying policy need for the Hub, whether that need is still relevant, and how the Hub's design addressed the need identified in the Williams Review.

2.1 The rationale for a Hub

2.1.1 The need or gap the Hub was established to address

The Hub was established to meet a gap in the availability of independent, applied research capacity and expertise relevant to NSW as identified in the Williams Review.

At the time of the Williams Review, bushfire management was guided by the EBMP and the Living with Fire Strategy. This focused strongly on hazard reduction burn targets, which were criticised for generating poor air quality conditions in the Sydney Basin (which raised community concerns about the health impacts of bushfire management), and for having adverse impacts on the fauna and flora of local environments.[18]

New practices were also emerging to support more targeted bushfire management. For example, the Victorian Government introduced a risk-based approach to fuel management in 2016.[19] This approach used simulation models of fuel hazards and potential bushfires to guide management actions. This was perceived as cutting edge research that may better inform bushfire management. Due to the unique landscape and ecology of NSW, NSW policy and operations could not readily be informed by interstate research.

Several stakeholders consulted for this evaluation reflected on the prevalence of competing views about the relative merits of hazard reduction and risk mitigation approaches at that time. They suggested that such competition reinforced the need for an independent and evidence-based voice to guide bushfire management policy and operations. They believe that an impartial Hub with the appropriate research capabilities would go a long way to addressing that need.

The Hub also offered opportunities for NSW to leverage insights generated by researchers in other jurisdictions and tailor those insights to NSW's specific bushfire needs.

[18] Broome, R. A., Johnston, F. H., Horsley, J., & Morgan, G. G. (2016). A rapid assessment of the impact of hazard reduction burning around Sydney, May 2016. *The Medical Journal of Australia*, 205(9), 407-408. Hannam, P. (2017). *'No warning': Calls for earlier pollution alerts after smoke cloaks Sydney again*. Accessed 1 April 2022: https://www.smh.com.au/environment/no-warning-calls-for-earlier-pollution-alerts-after-smoke-cloaks-sydney-again-20170815-gxwh6r.html.

[19] Forest Fire Management Victoria (2020). *Bushfire risk*. Accessed 1 April: https://www.ffm.vic.gov.au/fuel-management-report-2018-19/statewide-achievements/bushfire-risk.

While the Williams Review found that the Department and collaborators had generated high-quality research between 2002 and 2017, the research was under-resourced, and priority areas remained unexplored (e.g. the relative costs and benefits of fire risk-mitigation options). The Review took a strong position about the value of the relationship between the Department and the UOW. It suggested that the relationship must be 'maintained and enhanced'. It argued that dissolving or weakening the relationship would not be cost-effective and would be 'counterproductive to all parties involved'.[20] Furthermore, a lack of expertise and capacity within the Department to undertake the breadth of bushfire research required provided a further policy rationale for the Department to continue and increase its investment in collaborative and applied bushfire research.[21]

In addition, the Hub's establishment sought to reconcile the competing positions inside and outside the Department on fire management that reduce the risks that fires pose to natural and cultural heritage values, as defined under the NPW Act. The Department's Request For Tender (RFT) document that was issued to potential applicants recognised the need for research that acknowledged and accommodated the 'trade-offs' that arise in the course of managing a 'complex interface between science, policy and on-ground practice'. The RFT required applicants to identify how they would use partnerships to advance knowledge in three areas that represented the different positions of stakeholders involved in bushfire management. They included:

- *Understanding environmental factors driving variation in fire regimes at a landscape scale in relation to geology, soils, climate, and topography (which combine to determine ecosystem productivity and therefore fuels).*
- *Understanding the effects of changed fire regimes on emissions of greenhouse gases and particulates, on the carbon cycle and air quality.*
- *Understanding the complex interactions among climate, landscapes, fire regimes, biodiversity and cultural heritage values.* [22]

The UOW's response (i.e. the offer of six integrated WPs that directly addressed the different positions of key stakeholders through a collaboration) was deemed to reflect best the competing priorities, complexities and needs of the Department at that time (see Chapter 4 for additional analysis on WP design).

Key Finding 1 The need for the Hub

The Hub was established to address a gap in the availability of independent, applied research capacity and expertise tailored to the NSW context.

Source: ACIL Allen

2.1.2 Hub alignment with broader Government initiatives

A.1 To what extent is the program relevant to NSW needs and priorities?

The Hub was established to align with several NSW Government strategies and programs, notably the Living with Fire Strategy, the EBMP and Part 6A of the Energy and Utilities Administration Act 1987. The Hub's evaluation plan (a key foundational document) also requires consideration of the extent to which the Hub aligns with the purposes of the CCF and the OEH Knowledge Strategies. These strategies and programs (while concluding in 2022 and 2017 respectively) continue to drive investment in climate change initiatives and programs that reduce emissions (including through the

[20] Williams, RJ. (2017) – Key Finding 4.

[21] Williams, R.J. (2017). Op. cit.

[22] OEH (2017) RFT: Part A and B.

Net Zero Plan, the NSW Climate Change Policy Framework and NSW State Outcome).[23] They represent a significant NSW Government investment in policy and programs.

These Government policy, strategy and program initiatives shape and inform the work of the Hub and are embedded in its core architecture and rationale.

As part of this evaluation, ACIL Allen has considered how well the Hub's design is aligned with Government's key policies and strategies. We have undertaken this analysis at the WP-level as it best demonstrates how well the Hub's design aligns to the policy intent.

Table 2.1 presents an assessment of the Hub's alignment with these policies and strategies. We have analysed how well the aims of each WP align with the Living with Fire Strategy, the EBMP, the CCF and the Knowledge Strategies (see section A.4). A more detailed analysis of WP performance is provided in chapter 5.

The analysis shows very strong level of alignment between the aims of the WPs and the Living with Fire Strategy and the EBMP. Given that the Hub was established to address the key issues underpinning these policies, strong alignment is expected.

The WPs are also closely aligned with the CCF. The legislative purposes of the CCF[24] are very specific and relate to the Act's key focus (electricity and water utilities), that is to reduce GHG emissions and the impacts of climate change associated with water and energy activities; to encourage water and energy savings and the recycling of water; to reduce the demand for water and energy; to stimulate investment in innovative water and energy savings measures; to increase public awareness and acceptance of the importance of climate change and water and energy savings measures; and for the purposes of national energy regulation. As might be expected, given the purposes focus on energy and water, the alignment between the WPs and most of the explicit purposes of the CCF is weak (with the exception of WP3 and reducing GHG emissions).

However, the NSW Government has taken a more expansive view as to the remit of the CCF as indicated in the following excerpt from the *NSW Climate Change Fund Annual Report 2020-21*[25]

> *"The NSW Climate Change Fund invests in initiatives to reduce carbon emissions, generate clean energy, lower energy bills and make NSW communities more resilient to the impacts of climate change."*

Accordingly, the Hub's alignment is assessed against four CCF objectives: reduced GHG emissions; clean energy; lower energy bills; and building resilience. This shows WP5 and WP6 to be fully aligned, and WP1 closely aligned, with the CCF, particularly the intent around reducing emissions and building resilience.

The Landscape Management, Biodiversity and Climate Change Impacts and Adaptation Knowledge Strategies are the next most closely aligned with the WPs, particularly WP1, WP3, WP4 and WP6. However, it is not clear from the foundational documents (like the Program Logic and Evaluation Plan) whether these strategies actually drove the research undertaken under WPs, even though ACIL Allen found alignment between them. Also, the stakeholders consulted did not identify that the strategies were strong drivers in the design and delivery of WPs. Other more immediate or operational issues were often the core drivers of the Hub's activities.

The remaining Knowledge Strategies are poorly aligned with the WPs. ACIL Allen considers this appropriate given that the Knowledge Strategies lapsed during the design and start up phases of

[23] Department of Planning, Industry and Environment (2020). *Net Zero Plan Stage 1: 2020–2030*. Sydney: State of NSW.

[24] *Energy and Utilities Administration Act 1987 No 103, Part 6A, Water and Energy Savings,* December 2021

[25] NSW Department of Planning, Industry and Environment (2021). *NSW Climate Change Fund Annual Report 2020-21*. Parramatta: NSW Government.

the Hub (they operated from 2013-17) and that they cover a broad range of sectors that are not directly related to bushfires.

Table 2.1 Alignment of WPs with NSW needs and priorities

Strategy/program name	WP1 – Dynamic mapping & analysis of NSW fire regimes	WP2 – Fuel, flammability & carbon dynamics	WP3 – GHGs, particulate emissions & air quality	WP4 – Fire regime Thresholds of Potential Concern for threatened biodiversity	WP5 – Health & social benefits of Indigenous fire management	WP6 – Optimisation of cost-effective fire management
Living with Fire Strategy (2012-21))	●	●	●	●	●	●
Enhanced Bushfire Management Program (2011-22)	●	●	●	●	●	●
Climate Change Fund Strategic Plan (2017-22)	◕	◔	◑	◑	●	●
OEH Knowledge Strategies (2013-17)						
– Landscape Management Knowledge Strategy	◕	◔	○	◔	◔	◑
– Biodiversity Knowledge Strategy	◕	◑	◔	●	◔	◕
– Resource Efficiency Knowledge Strategy	◔	○	○	○	○	◔
– Pollution Knowledge Strategy	◔	◔	●	○	◔	◑
– Climate Change Impacts and Adaptation Knowledge Strategy	◑	◔	◕	●	◔	◑
– Water and Wetlands Knowledge Strategy	◔	○	○	○	○	○
– Coastal, Estuarine & Marine Environments Knowledge Strategy	○	○	○	○	○	○

Note: ○ no alignment, ◔ some alignment, ◑ moderate alignment ◕ large alignment, ● full alignment.

The analysis is based on an assessment of the alignment between the WP aims and priorities/objectives/purposes of each strategy, policy and program.

Source: Energy and Utilities Administration Amendment (Climate Change Fund) Act 2007, OEH Knowledge Strategies, Project Plans WP1-6, EBMP Monitoring, Evaluation and Reporting Framework

Since the Hub's establishment, the severity of the 2019-20 Black Summer Bushfires highlighted the strong continuing need for policy and operational research and advice. As discussed in sections 5.2.2 and 6.1 of this report, the Hub played an important role in supporting Government's Inquiry into the events of that season.[26]

Moreover, the Hub was also established to address a multi-disciplinary capability gap within the Department. It requires a solid evidence-base to develop effective policy and fire-management operational procedures. Chapter 6 discusses the different ways in which the Hub (through its WPs and interactions with end users) the Hub sought to address this capability gap.

[26] Stone, C. (2021). *NSW Government announces new $28 million mission to tackle bushfire threat*. Accessed 15 April 2022: https://nswliberal.org.au/Shared-Content/News/2021/$28-million-mission-to-tackle-bushfire-threat.
NSW Government (2020). *Bushfire Industry Recovery Package*. Accessed 15 April 2022: https://www.nsw.gov.au/regional-nsw/regional-recovery-programs/bushfire-recovery/bushfire-industry-recovery-package.

According to stakeholders consulted for this evaluation, this capability gap exists today. This gap can be partly attributed to how key insights from the Hub's research outputs have been translated or extended to end users. While it is not feasible (given current funding constraints) to have the research capacity equivalent to four major university research departments, and thus undertake the multi-disciplinary research in-house, the Department could address operational capability gaps through a more effective and systematic translation of the Hub's research findings.

For these reasons, there remains a strong rationale for Government to fund a research Hub that delivers independent, applied research capacity and expertise tailored to the NSW context which can be used to support planning and operations.

Key Finding 2 Alignment with key Government initiatives

The WPs align most closely with Living with Fire Strategy and EBMP. There is a lower level of alignment between the Hub and most Knowledge Strategies and the CCF.

The need for a collaborative Hub remains as shown by the severity of 2019-20 Black Summer Bushfires, the findings of the Inquiry and the ongoing lack of the required multi-disciplinary research capability within the Department and individual research institutions.

Source: ACIL Allen

2.2 The Hub's design

2.2.1 The hub and spoke model

The Hub was designed to be a hub and spoke model, where a lead organisation coordinates the activities of a range of nodes or work packages. The Department proposed this design in the Request for Tender (RFT) for the Hub. The tenderers refined this in their proposals.

The RFT outlined the services and areas of focus required by the Department and the nature of the grant funding agreement to be signed between the Department and the successful tender(s).[27] The process encouraged tenderers to elaborate on the design the Hub and identify innovative consortia-based approaches to deliver the required services. This provided tenderers with the flexibility to develop a consortium of leading experts in bushfire research with strong existing relationships.

The final Hub and WP design were agreed upon following negotiation with the Department. The Department did not seek to merge tender offerings or select elements of different tenders to create alternative options. This would have created additional work and complexity for the Department with minimal perceived benefit.

A grant mechanism was used to deliver the Hub. The grant provided flexibility in the design stage, allowing the Hub researchers to support the Department to define the knowledge gaps early on and tailor the Hub to address the specific problems as they emerged over the life of the Hub. Some issues and gaps emerged later in the delivery of the WP. These gaps reflected other issues (e.g. support for the Bushfire Inquiry and the loss of key personnel) and were not relevant to the use of a hub and spoke model for the Hub's design.

Stakeholder views about the model

Stakeholders presented mixed views on whether the Hub was the most effective model for addressing the gap. Most stakeholders considered that the Hub was an innovative way to build on pre-existing partnerships and complementary skill sets across a range of researchers and

[27] Office of Environment and Heritage (2017). *Request for Tender Part A and B*. Op. cit.

universities. The Hub provided a focus for people to work together on a suite of issues and share knowledge across disciplines. This allowed the researchers to explore challenges that were too broad and complex for individual researchers or institutions to address.

Some stakeholders believe that a grant-funded consortia model provided strong value for money and closer collaboration between the Hub's research partners and the Department in comparison to an approach whereby the work was conducted through multiple individual contracts. Their rationale is that a grant (as opposed to a contractual) mechanism provided the flexibility needed to design the Hub and its WPs to best meet end user needs. They believe that a commercial contracting arrangement would have been inconsistent with the collaborative intent of the Hub and would have encouraged greater individualisation of effort by partners, thus reducing the Hub's overall value proposition.

The five-year funding envelope provided the Hub financial security. It reduced the likelihood of budget cuts and reduced outsourcing risks. The model also streamlined the Department's administrative role, with the UOW responsible for distributing funding to the partner universities.

Some stakeholders suggested the research could have been undertaken through other mechanisms. Some commented that individual or coordinated procurements through CSIRO or the then Bushfire and Natural Hazards Cooperative Research Centre (CRC)) could have better linked the Department's needs with a broader ecosystem of multi-disciplinary experts across Australia. They believed that a national body like CSIRO would have the integrative capacity to undertake research that addressed the competing priorities of bushfire management in NSW. They also believed that selecting different providers for each WP depending on specific expertise and capabilities could have yielded additional benefits (such as access to different economic and environmental modelling capabilities not available to the WP leaders). These views are a matter of perspective, and it is not clear whether other organisations would have delivered these claimed benefits.

In contrast, some stakeholders considered a different approach may have led to a fragmented, uncoordinated, and less collaborative set of arrangements.

Appropriateness of the model

On balance, the model was appropriate for addressing the need. It allowed sufficient flexibility for the researchers to assemble a fit-for-purpose consortium; for the researchers and the Department to co-design the research problem, WP themes, activities and outputs; and for the researchers to work collaboratively with the Department and end users over the life of the Hub. The model provided ample opportunities to build a 'critical mass' of coordinated expertise, which was deployed at short notice to support the Bushfire Inquiry. To this end, the Hub's model was an appropriate way of delivering against the need identified by the Williams Review and meeting the changing circumstances brought about by the 2019-20 bushfires.

Key Finding 3 The hub and spoke model

> The hub and spoke model was appropriate. It provided flexibility for the researchers to assemble a fit-for-purpose consortium; for the researchers and the Department to co-design the research problem, WP themes, activities and outputs; and for the researchers to work collaboratively with the Department and end users over the life of the Hub.

Source: ACIL Allen

3 Governance, management, monitoring and evaluation

Strong governance and management arrangements are necessary for program implementation and delivery. Monitoring and evaluation guide the collection of information to assess program implementation, delivery and performance. This chapter considers the Hub's governance and management arrangements and whether the monitoring and evaluation processes were sufficient to support an assessment of the Hub's performance.

3.1 Governance model

3.1.1 Hub Steering Committee

The Hub Steering Committee provides oversight, guidance and monitoring of the delivery and performance of the Hub and WPs (as overviewed in section 1.2.4).

The Hub Steering Committee comprises diverse members with high-level expertise and necessary representation from the Department, government end users (i.e. NPWS, RFS and NSW Ministry of Health), researchers, and independent experts. Stakeholders considered the diversity and experience of the members to be a strength of the committee.

The Hub Steering Committee operates as a Hub control board. It is responsible for the management of the Hub's overall performance against its strategic intent. It does not consider the Hub's day-to-day activities and progress (including amendments to WP activities), which is overseen and approved by the respective Working Groups. Any significant issues are identified through progress reporting and discussed during Hub Steering Committee or Working Group meetings. The Knowledge Exchange Officer (discussed further in section 3.2) also communicates issues arising for each WP to the Hub Steering Committee and acts as a conduit between the Working Groups and Steering Committee.

The Hub Steering Committee considers summary status reporting for the Hub regularly (a total of 16 meetings over the life of the Hub) focused on communication and publications, staffing, finances (including leveraging of funds), and WP progress and immediate plans. Risk was added as a Steering Committee agenda item for the March 2022 meeting. This means that a risk management plan was not part of the Hub's establishment phase and that the process of identifying and then mitigating risks did not form part of the early stages of Hub governance. Several stakeholders considered that the Steering Committee had not adequately considered risk planning and mitigation over the delivery of the Hub and identified the need for more formal risk planning. This was seen to be particularly important to end user engagement, research translation and end of life planning for the Hub (discussed further in section 6.4).

Two significant issues have emerged with the delivery of the Hub and WPs that have required Hub Steering Committee review and approval.

One issue related to the Bushfire Inquiry (see section 6.1). Following the 2019-20 Black Summer Bushfires, the NSW Government called for an inquiry into the causes of, preparation for and response to the bushfires. The Hub was commissioned to complete 19 projects to address knowledge gaps for the Inquiry. This required the Hub to put planned Hub projects on hold for three months while these projects were completed. The Steering Committee agreed that the Hub provide research and analysis for the Inquiry and recognised this would likely impact the Hub's resources and delivery capacity. The Steering Committee later approved additional resources and revised timeframes for the WPs.

The second issue related to the reprioritisation of work. The Hub was set to deliver research on quantifying and better understanding Holocene fire regimes. Subsequently, the UOW was funded to complete similar work through an ARC Discovery Project. The Hub reprioritised the funding allocated to this project to instead focus on deriving cost-effective risk management solutions. This was guided by feedback from the Department and approved by the Hub Steering Committee in November 2018.

3.1.2 Working Groups

E.3 To what degree is there local ownership of program results?

The Hub Steering Committee oversaw the establishment of the Working Groups, which comprise the WP researchers, various end users (i.e. the Department, RFS, NPWS, NSW Ministry of Health and Crown Lands) and the Knowledge Exchange Officer.[28] The end users generally held operationally-focused management roles in their respective organisations.

Working Group meetings are held twice annually. The Working Groups work with WP researchers to understand and advise on the research, approve project proposals and budget allocations, monitor the achievement of milestones and deliverables (regarding the WP project plan and annual roadmap), and monitor risks, budget and financial reporting, quality and timeliness.[29]

Stakeholders presented mixed views about the effectiveness of the Working Groups and their ability to provide guidance and direction to the WP researchers.

Most stakeholders considered that Working Group meetings provided an opportunity for researchers to understand the needs of potential end users and for end users to engage with researchers and shape the development of the research and its outputs to meet their needs. This aimed to facilitate a sense of local ownership of the Hub's outputs.

Some stakeholders noted that the while Hub Steering Committee played an important role in encouraging end users to participate in the Working Group meetings, it was sometimes difficult to achieve "deep" end user engagement through Working Group meetings. These stakeholders felt that more effort was required to achieve engagement (e.g., requiring a specified amount of staff time to be dedicated to the Working Groups) and more effectively incorporate the perspectives of operational staff (i.e. on-the-ground fire managers) into the WPs.

Some stakeholders also felt that involving the Department's policy staff to a greater degree may have helped operationalise the Hub's outputs and disseminate these more broadly among end users. A key learning from this evaluation is that more thought will be needed during the design phase of a collaboration to ensure effective end user engagement in developing and translating research outputs.

Some stakeholders noted it was challenging to ensure that Working Groups members attended the meetings and advised on progress and plans for each WP. This is evidenced in the minutes for the

[28] Office of Environment and Heritage (2017). *Bushfire Research Hub Steering Committee Terms of Reference - V1.2*. Sydney: NSW Government.

[29] Unknown author (2018). *Bushfire Risk Management Research Hub – Working Groups Terms of Reference*.

Working Group meetings, where some WPs consistently show several apologies from Working Group members. The Steering Committee was the nominated forum within the Hub's governance model where Working Group attendance, participation and commitment should have been discussed. However, we have identified limited evidence that the Steering Committee consistently performs this oversight role.

Also, some stakeholders questioned whether the frequency and conduct of Working Group meetings were sufficient to meet the guiding principles and intent of the Hub. We believe this indicates the need for a future Hub to establish more robust processes for end user engagement at all stages of the research process. That is, a future Hub must find ways to engage end users in the research process that exceeds two meetings per year and ad hoc engagement. A strong and well-planned collaboration pathway will provide many more formal and informal opportunities to shape the research design, appropriately influence its conduct and find opportunities to extend the research findings into practice. This means that bi-annual Working Group meetings are potentially insufficient to deliver the end user engagement envisaged for the Hub. It is important to note that the Forestry Corporation, which is responsible for managing more than two million hectares of State forests (a significant area relative to the NPWS's 7 million hectares),[30] has not contributed in a more significant way to the Hub. The Forestry Corporation has one representative member on the Working Group for WP1 (who infrequently attended) and has not been involved in other Working Groups or specific research topics. Instead, the Hub focused solely on fire management operations and policy targeting NPWS and RFS, with any research outputs made publicly available on the Hub website. While the remit of Working Groups is to provide end user engagement in the WPs, any form of deeper or more meaningful engagement through the Working Groups would have benefits for the coordination of fire management activities across key land managers in the state.

3.1.3 Additional stakeholder views about the governance model

Hub researchers and those involved in the Hub Steering Committee and Working Groups considered the governance model efficient. They also report appropriate levels of oversight, although there are mixed views between the researchers and Hub Steering Committee/Working Group members on the value of Hub progress reporting.

One benefit of the Hub model (as supported by stakeholders) was the single contract held between the government and the UOW, which effectively outsourced the Department's governance and management of the partners and funding arrangements to the UOW.

Stakeholders generally considered that the WPs had sufficient financial flexibility (largely within the original funding envelope) to amend the research plans as needed and as approved by the Working Groups and Hub Steering Committee to deliver on the intended outcomes. The amendments noted above to account for the Inquiry and the redesign of the Holocene research demonstrate that the Hub has been sufficiently flexible to reprioritise research efforts and funding as needed. This flexibility is essential for a five-year collaboration where the Government's needs and priorities are likely to evolve.

Working Groups were considered a sensible approach to engaging end users in the design and delivery of the research. This allowed the researchers to be nimble and flexible in how the research was conducted, amendments to be made to projects, and new research proposed and accepted. This also supported some local ownership of the Hub's outputs, such as FireTools, which is well-used within NPWS and influential for fire management.

However, several stakeholders suggested the Working Groups did not deliver as much value as possible due to low engagement by some end users, lack of ability to influence the research and

[30] Forestry Corporation (n.d.). *Welcome to Forestry Corporation of NSW*. Accessed 22 April 2022: https://www.forestrycorporation.com.au/.

not having the 'right' level of representation or resourcing available to participate in the Working Group. Some participants did not have the authority or capacity to canvas opinions among end users in each organisation to provide consolidated input into the Working Group discussions. This is despite the fact that the Hub had a Communications Plan[31] that segmented stakeholders, identified channels for communication, considered the key messages to be communicated and identified the Hub's communications risks and mitigation strategies.

Despite the governance structures and clear terms of reference for the Hub Steering Committee and Working Groups, the Hub struggled to obtain meaningful and prolonged engagement from all key end users. Several stakeholders noted that stronger buy in could have improved the extent to which the outputs were translated and embedded in key end user agencies, such as NPWS and RFS. This is further discussed in section 4.1.

Key Finding 4 Delivery of the governance model

Overall, the Hub's governance model is efficient, effective and appropriately configured.

The Hub Steering Committee, akin to a board, is comprised of diverse, expert and representative members. It manages high-level performance, not day-to-day progress. It should have been more proactive in adequately planning for and mitigating risk.

Working Groups are generally representative of end users and encourage engagement with the research and outputs. However, there may have been opportunities for Working Groups to foster more knowledge transfer and local ownership of the outputs with stronger end user engagement through the implementation of a dedicated strategy or plan.

WPs had sufficient financial flexibility to amend research plans as needed.

Source: ACIL Allen

3.2 Management model

The Hub has an informal management model. Each WP has been delivered by a respective Chief Investigator, who is responsible for managing the WP's day-to-day research, engaging suitable researchers, and reporting on WP plans and progress. This model is consistent with the research management models used by significant research granting agencies such as the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC).

The Hub Chair broadly managed engagement and was responsible for resolving any issues arising across the researchers or WPs. This role is central to the Hub operating effectively, particularly in terms of the strategic vision for the Hub and the relationships and partnerships formed across the Hub. As such, the design phase should have considered the risks created by this central role and the necessary contingencies should the Hub Chair prematurely leave the Hub. It could have built some additional flexibility into the terms of reference for the Hub Steering committee by allowing the Hub Chair to maintain a 'formal' advisory role in its management (despite not being part of the Hub's delivery per se). The Chair departed three quarters of the way through the Hub's program which caused challenges with continuity.

Some stakeholders considered that the new Hub chair did not play as active a role in the management of partners, timeframes and deliverables (there was a strong contrast between the two Chairs).

However, some stakeholders considered that the Hub Chair did not need to perform a strong management role as the Hub was largely self-managed. Researchers worked in discrete areas or generally worked well together where research activities aligned, and it was sensible to do so. This

[31] OEH (2017). *Bushfire Risk Management Research Hub: Communication Plan* 8 November (draft).

collaborative approach was seen to create efficiencies in data collection and synthesis. For example, WP6 draws on research by the other WPs, and forms a capstone project for the Hub.

However, given the challenges with applying the Hub's research and for planning for the end of WP activities, there is a missed opportunity for the Hub Chair to operationalise the Steering Committee's strategic advice.

Stakeholders considered that there were no issues with overlap or duplication that the researchers could not resolve. Further, as the design of the WPs and funding arrangements were agreed upon at the start of the Hub, no disagreements arose about funding. This meant that Hub resources and time were not consumed in resolving disputes between partners, which can be a feature of some collaborative arrangements that ACIL Allen has evaluated.

The Knowledge Exchange Officer played an important role in supporting the Hub Steering Committee and Working Group meetings and performing project management, administrative duties and knowledge management activities (as directed by the Chair of the Steering Committee).[32] Many stakeholders considered this to be a valuable role that supported the Hub to operate effectively and deliver on the contract's requirements (i.e. by overseeing regular progress reporting). This feature is not always present in the design of research collaborations, so the Department and the Hub partners should be congratulated for including it in the Hub's delivery model.

However, all stakeholders commenting on the Knowledge Exchange Officer role considered that the role's scope was too large. Most stakeholders believe that the administrative and knowledge management functions should have been separated (and potentially delivered by two FTEs). While a research assistant was employed for part of the Hub's lifespan and supported reporting, coordination, and organisation of the 2019 and 2020 Hub conferences, the role was not continuous.

Splitting the role would have allowed the Knowledge Exchange Officer to focus exclusively on knowledge management, translation, and brokering relationships between Hub participants and end users. Instead, too much of the Knowledge Exchange Officer's time was spent on administrative duties (i.e. organising minutes, meeting agendas, progress reporting). This may have limited the opportunities for the Hub to extend and translate its research amongst end users.

Key Finding 5 Delivery of the management model

The streamlined management model was largely appropriate for the needs of the Hub and Hub researchers.

The Knowledge Exchange Officer role was highly valued. However, it could have delivered more value if better-resourced and focused solely on knowledge transfer and research translation, which would require sperate resourcing to deliver administrative functions).

Source: ACIL Allen

3.3 Monitoring and evaluation model

3.3.1 The program logic

B.3 How could the program be more effective in achieving its results?

The Hub's program logic (as part of the Hub's core design architecture) has somewhat shaped its operations, management and governance (see Appendix A.4). A draft program logic was developed for the Hub's RFT. The program logic was refined following the selection of the UOW as the host. The program logic was also used to shape the Hub's KPIs, reporting arrangements and

[32] Office of Environment and Heritage (2017). *Bushfire Research Hub Governance arrangements - Document Version 1.0*. Sydney: NSW Government

evaluation framework following its establishment. However, there was some misalignment between the program logic and these other artifacts, which undermined their utility later in the Hub's life.

The use of program logic was not required under the Department's monitoring and evaluation requirements (due to the size of the Hub's funding envelope and arrangements). However, it was a useful addition to the Hub's architecture and was developed to support its implementation. To this end, creating a program logic is consistent with best practice. It should provide the foundations for a consistent monitoring, evaluation and reporting framework/process throughout the Hub's lifetime.

Ideally, a program logic should be used as part of a program's core architecture to set the parameters of its operational, performance and accountability arrangements. A program logic should guide program managers through the development of activities, which lead to clearly articulated outputs and outcomes that align with the program's core intentions or objectives. However, it is not clear that the Hub's program logic has been a significant driver of these arrangements since its establishment.

For example, it is difficult to see the line of sight between the program logic and the six WPs. While an informed reader can infer the relationship, this opaqueness has made it difficult to report on the Hub's progress at the activity level. This point is important because the WPs are key drivers of Hub deliverables, which are, in turn, key inputs into the intermediate outcomes and impacts of the Hub. Without a clear link between the WPs and the outcomes/impacts, it is difficult to independently attribute which WPs have made the greatest/least contribution to the Hub's outcomes and thus its objectives.

Moreover, best practice program design would typically see a program logic developed in close collaboration with the WPs (the core activities of the Hub's resources) as they are being defined and assembled. This is an important design step that helps to ensure maximum alignment between a program's activities and objectives and clarifies its pathway to impact. However, the Hub's program logic was developed in relative isolation and after the design of the WPs. This suggests that the program's underpinning logic did not inform the design of the WPs, as best practice would recommend. We see this as an opportunity lost for the Hub. There is a need to better articulate the potential value of a program logic to research partners in the future.

The WPs do not have a strong reference point or design anchor which creates potential for the work under each WP to drift or delay. It also makes it more difficult for the Hub's governance model to detect when drift or delay occurs and take remedial action that realigns the activities to the core program architecture.

Key Finding 6 The program logic

While the development of a Hub program logic should be commended, it was not effectively leveraged to support the Hub's operations, management, governance, monitoring and evaluation activities.

There is poor visibility of the relationship between the program logic and WPs, which limits an assessment of WP performance and the extent to which the governing bodies can guide the Hub's activities. This represents an opportunity missed to design and deliver a Hub that is underpinned by a program logic which can drive all monitoring, evaluation and reporting activities.

Source: ACIL Allen

3.3.2 Key performance indicators

The Hub's Key Performance Indicators (KPIs) were developed by the Knowledge Exchange Officer (using personal experience and past consulting reports) after it commenced. They were designed to monitor and evaluate the Hub's progress and provide the Hub Steering Committee with valuable insight into performance.

Progress against KPIs is reported quarterly through Hub-level status reporting (see section 3.3.3), as reviewed by the Hub Steering Committee, and twice annually through WP progress reporting, as reviewed by the Working Groups. However, progress is only reported against 14 of the 21 KPIs at the Hub level and 13 of the 21 KPIs at the WP-level (see Section 5.1 for a discussion on how Hub and WP performance is reported using these KPIs). Consultation also suggests there was a weak link between Hub and WP performance reporting and Steering Committee decision making, suggesting that the reporting had little impact on Hub planning and prioritisation. Reporting also varies across the WPs, with WP3 reporting on the fewest KPIs (3 of 21) and WP2 reports on the most (6 of 21). A full list of KPIs that are and are not reported on is provided in Appendix A.3.

As only a selection of KPIs (and therefore outcomes) are reported, the reporting does not provide comprehensive visibility of the Hub's performance. Some key KPIs such as KPI 2 ("*New strategies for planned burning for the future delivered to direct stakeholders and implemented*"), which go to the core of what the Hub should deliver are missed completely. The reporting does not provide the Hub Steering Committee with the necessary performance information required to fully assess delivery risks, identify emergent issues, and take remedial action if required.

In addition, ACIL Allen observes that several of the KPIs measure the Hub's activities and outputs, not its outcomes and impacts – in reality very few of the KPIs address impact. This makes it challenging to develop a comprehensive picture of the Hub's overall performance and compare that performance to its intended outcomes.

Moreover, KPIs should be designed and used as scaffolds for collecting data that informs the evaluation of Hub performance. We have observed that only a selection of the KPIs relate to the evaluation questions outlined in the Hub's evaluation plan, further complicating data collection and their utility for evaluation purposes. Box 3.1 demonstrates this disconnect as it relates the issue of equity. This may reflect that the evaluation plan was developed following the Hub contract signing and initial WP planning stages. Future evaluation planning should ensure that KPIs clearly drive data collection to address the evaluation questions.

Box 3.1 Evaluating equity

The equity of the Hub is to be assessed according to the following three evaluation questions and unrelated KPIs:

- *To what extent do the program targets treat vulnerable communities, sectors and regions equitably?*
  and
  To what extent have regional issues been considered in identifying risks and opportunities, and developing tools?
  are to be addressed using the KPIs:
  - Strategies are defined, summarised and disseminated to target groups
  - Influences are summarised and disseminated to 100% of target groups.
- *To what extent has the program targeted high-climate-risk areas and communities?*
  is to be addressed using the KPIs:
  - Identified changes are listed, summarised and disseminated to target groups
  - Hub SC approved research papers submitted.

Source: ACIL Allen drawn from the OEH Evaluation Plan - Bushfire Risk Management Research Hub (2017).

Table 3.1 provides some analysis and observations about the KPIs as they are currently drafted. The table also highlights some opportunities for improvement if these KPIs are to be refined and used for any future bushfire research initiative.

Table 3.1 Hub KPI analysis

Selected Key Outcome/Output	KPI, Baselines, and Targets	Observation about the KPI
Costs, benefits, and implications of managing fire risk are better understood within agencies and by the public and facilitate change	KPI 1: Optimal, cost-effective approaches for planned burning defined Target: Report complete June 2022	KPI is too input and activity focused. It does not demonstrate whether the report has led to a better understanding (within agencies and by the public) of managing fire risk. It does not demonstrate that the report has in anyway supported behavioural change.
	KPI 2: New strategies for planned burning for the future delivered to direct stakeholders and implemented Target: OEH and RFS implement strategies post June 22	KPI is fine. However, could be enhanced by some measure of stakeholder value or implementation progress.
Partnerships and knowledge exchange underpins landscape fire management policy development, decision-making and evaluation	KPI 3: Count of policies and operations developed and updated through information from the Hub Target: More than 0; post June 22	KPI is a partial measure of performance. Some additional consideration of the degree to which stakeholders value or use the updated policies or operational manuals will provide an additional level of performance information from this KPI.
Reputation and research capabilities leverage greater investment and deliver research	KPI 4: 3:1 Leverage research from OEH funds achieved and Program completed Target: Budget and program report complete June 2022	KPI is fine and a strong articulation of research performance.
Scientifically rigorous information informs and meets OEH, CCF and partner priorities	KPI 5: Hub projects inform and meet: OEH Knowledge Strategies, CCF Objectives or EBMP Objectives Target: 100%; June 2022	KPI identifies policy alignment as a key aspect of performance, which is appropriate. However, it does not provide any suitable measure of scientific rigour. Journal impact factors and peer review outcome measures are a more appropriate way of determining scientific rigour.
Research information and data are readily available in forms that different target groups can access, easily understand and use	KPI 6: Identified target groups of Hub agree they have access and can understand and use information Target: 100% access; 80% understand, 60% use; June 2022	KPI is fine as it seeks to understand whether the information is used, understood and valued.
Planned burning strategies which will have least impact on air quality and reduce risks to threatened biodiversity are defined	KPI 7: Strategies are defined, summarised and disseminated to target groups Target: 100%; June 2022	KPI is fine and closely aligned to the outcome/output.
Influences of cultural burning on health and well-being of Aboriginal people, and the wider community is better understood	KPI 8: Influences are summarised and disseminated to 100% of target groups Target: 100%; June 2022	KPI is an activity indicator and only partially reflects the intent of the outcome/output. It does not identify whether target groups understand the influences and thus support behavioural change.
Changes in fire management needed to successfully adapt to future climatic and human changes are identified and better understood.	KPI 9: Identified changes are listed, summarised and disseminated to target groups Target: 100%; June 2022	KPI is an activity indicator and only partially reflects the intent of the outcome/output. It does not identify whether target groups understand the changes and thus support behavioural adaptations.
Productive partnerships build research capability and support knowledge exchange	KPI 10: Hub Steering Committee (SC) meet biannually and establish objectives Target: 100%; June 2022	KPI is a process indicator which does not identify any element of performance.

Selected Key Outcome/Output	KPI, Baselines, and Targets	Observation about the KPI
	KPI 11: OEH/NPWS staff assigned and involved in each WP from start to finish, PhDs established, host researchers and OEH/NPWS staff co-located Target: At least one science and one policy/operation staff member assigned to each WP; 4 PhDs;1400 work hours completed by UOW and OEH staff or more at co-location sites	KPI 11 & 12 are focused on effectively resourcing knowledge exchange. They could be combined into a single KPI focused on resourcing, with the staffing and funding elements being the targets for a combined KPI.
	KPI 12: Knowledge exchange funded and SC approve and endorse: project plan, OEH communication and engagement strategy, Host Communication Plan Target: 100% complete; March 2017	
Mapping and monitoring fire regimes across all NSW ecosystems is revolutionised and automated	KPI 13: Online fire regime interfaces & tools launched. Fire regime automation and decision support systems implemented Target: December 2021; June 2022	KPI is fine.
Predictive modelling for fuel types and flammability accounting for multiple scales in environmental variation across NSW is developed and integrated	KPI 14: State-wide models of fuel, moisture and carbon dynamics developed. Fuel, moisture and carbon forecasting capacity implemented and integrated. Target: December 2020; June 2022	KPI is fine.
Holocene fire regimes are quantified and better understood	KPI 15: Regimes are quantified, summarised and disseminated to target groups Target: 100%; June 2022	KPI is an activity indicator and only partially reflects the intent of the outcome/output. It does not identify whether target groups understand fire regimes, and thus support behavioural change.
Fire management's ability to mitigate GHGs and protect carbon stock is quantified and better understood	KPI 16: Management's ability is quantified, summarised and disseminated to target groups Target: 100%; June 2022	KPI is an activity indicator and only partially reflects the intent of the outcome/output. It does not identify whether target groups understand fire management's abilities and thus support behavioural change.
Peer-reviewed research papers	KPI 17: Hub SC approved research papers submitted Target: 100%; June 2022	KPI is a process indicator which does not identify any element of performance. Could be expanded to include finalisation/ publication of papers, but outcomes/impact are dependent on adoption and translation.
Baseline data, targets and benchmarks	KPI 18: Data Management Plan approved by Hub SC. Data stored, version controlled with metadata Target: 100%; June 2022	KPI is fine. Could be expanded to assess whether all appropriate data is 'captured'.
Advice/recommendations on policy and management	KPI 19: Direct involvement stakeholders agree they receive timely advice and recommendations from the Hub and the Project Manager Target: 80%; June 2022	KPI is fine.
Accessible and well-disseminated research	KPI 20: Hub SC endorsed OEH communication and engagement strategy is adhered to Target: 100% of projects adhere; June 2022	KPI is fine.
Regular reporting of performance and governance	KPI 21: Progress and Final Reports approved by Hub SC Target: 100%; June 2022	KPI is fine. However, there are opportunities to ask deeper, more meaningful questions about these reports e.g. the reports allow the SC to better manage risk, set direction, scrutinise performance etc.

Source: ACIL Allen, OEH Evaluation Plan - Bushfire Risk Management Research Hub (2017)

Key Finding 7 Key performance indicators

Only some KPIs are reported on and a number of the KPIs measure activity and/or output rather than outcomes and impacts. There are opportunities to enhance the performance orientation of a Hub's KPIs in the future and to develop the KPIs in collaboration with the Hub Steering Committee.

To facilitate a better assessment of the Hub's performance over time, the relationship between its KPIs, outcomes, objectives and evaluation plan could be strengthened. Moreover, more routine and comprehensive reporting of the KPIs would have provided the Hub's Steering Committee with higher quality and more timely performance information.

Source: ACIL Allen

3.3.3 Status and progress reporting

The Hub and WPs report on performance through WP-level progress reports and the Hub-level status reports. The reports are designed to monitor the status of the WPs and Hub, through a high-level summary of progress and more detailed reporting on risks, budget, decisions required from the Hub Steering Committee and progress on individual outcomes and milestones. Status comments provide details on the milestone or outcome status and any mitigation strategies or revised timelines for those 'behind schedule'. The reports are used as a compliance measure to ensure Hub partners meet funding obligations and expectations. They are not used or reviewed by a broader audience.

The design of the reports is useful and should provide the information needed by the governance and management arrangements to allow for performance monitoring. However, in practice, progress reporting has been inconsistent and incomplete.

Reporting for each WP does not consistently identify progress against each milestone and outcome. Some milestones and outcomes are reported for only a few progress reports before they are omitted from ongoing reporting. Additional administrative support would have guaranteed more routine reporting of milestones/outcomes across the WPs.

This is also the case for Hub-level status reporting. While this is appropriate in some instances where milestones are marked as 'completed' and are not reported on again, in many cases, milestones and outcomes are most recently reported as 'on track' or 'behind schedule'. In some cases, this status has not been reported on for multiple reports/years. This incomplete reporting makes it difficult to determine whether the WPs are delivering against all milestones and outcomes, and therefore whether the Hub is on track to achieve its objectives.

Some researchers considered that the reporting process was overly structured with inflexible reporting milestones and KPIs based on annual roadmaps developed at the start of each year. Some researchers considered that this did not align well with their need to pursue research opportunities organically as they arose and change priorities as needed. However, other stakeholders noted that the reporting approach was important for supporting researcher focus and accountability toward the intended outcomes of the WP and Hub.

Key Finding 8 Status and progress reporting

WP progress reporting for each milestone and outcome is inconsistent and incomplete. This makes it difficult to accurately determine whether the WPs and Hub are on track.

Source: ACIL Allen

Work Package design and planning 4

The WP design and planning set the foundations for the delivery of the WPs. This chapter considers the design and planning arrangements for the Hub's activities, engagement with end users, consideration of vulnerable communities, sectors and regions; regional issues; and high-climate-risk areas and -communities in WP design.

4.1 Work package co-design and co-delivery

4.1.1 Initial WP design

A.2 To what extent was there effective co-design and co-delivery with end users?

The Department proposed the initial three themes as part of the RFT process for the Hub.[33] These themes were refined by the UOW and partners and proposed as six individual WPs. The WPs broadly aligned with the Department's three themes but provided a more nuanced understanding of the research knowledge gaps and the research required to best support the Department's fire management needs. The WPs were refined with the Department during the contracting process.

As discussed in section 2.2.1, while the Department identified the initial research issues and designed the Hub approach, the UOW and Hub partners primarily drove the refinement of the research issues and the design process.

4.1.2 Iteration of WP design and delivery

The Working Groups have overseen ongoing iteration of WP design and delivery (at a day to day level) and Hub Steering Committee (at a strategic level). These groups are comprised of end users, as overviewed in Table 4.1. This table shows a broad range of participants, many of whom participated across the life of the WP and Working Groups.

Table 4.1 Working Group members

Work Package	Members (and example divisions/branches)
WP1: Dynamic mapping and analysis of NSW fire regimes	UTAS, NPWS (e.g. Park Programs), the Department (e.g. Climate & Atmosphere Science, Knowledge Services, Crown Lands, Remote Sensing and Regulatory Mapping, Metrics and Forecasting, Fire and Culture Science, evaluation), Forestry Corporation of NSW, RFS
WP2: Fuel, flammability and carbon dynamics	Western Sydney university, the Department (e.g. Vegetation Mapping, Fire and Culture Science), RFS, NPWS, ACT Parks and Conservation Service
WP3: GHGs and particulates	UOW, the Department (e.g. Atmospheric Research, Fire and Cultural Science), EPA (Strategic Policy Programs), NPWS
WP4: Fire Regimes and biodiversity	UNSW, NPWS, the Department (e.g. Science Division, Fire and Cultural Science, Impacts and Adaptation, Conservation Programs), RFS

[33] Office of Environment and Heritage (2017). *Request for Tender Part A and B*. Op. cit.

Work Package	Members (and example divisions/branches)
WP5: Indigenous cultural burning: exploring the links with cultural revitalisation and well-being	UOW, the Department (e.g. Cultural Fire Management Unit, Fire and Cultural Science), Firesticks Alliance, Blue Mountains World Heritage Institute, NPWS (e.g. Aboriginal Heritage Partnerships, Fire & Incident Management Branch), RFS, University of New England
WP6: Optimisation of cost effective fire management	UOW, the Department (e.g. Fire and Cultural Science, Knowledge Services, Knowledge Delivery, Evaluation), RFS (e.g. Community Planning), NPWS (e.g. Fire and Incident Management), EPA (e.g. Strategic Policy Programs), UTAS

Source: Working Group minutes for each WP

WP researchers most notably iterated the design and delivery of the WPs through engagement with the Working Groups. WPs developed annual Roadmaps and submitted ad hoc proposals for new research activities (which details the project name and description, chief investigators and partners, aims and objectives, methodology, deliverables, end user agreement, and funding and budget details). These were discussed with and approved by the Working Groups.

Working Group meeting minutes show that end users had the opportunity to comment on and ask questions regarding the proposed Roadmaps for each coming year. Working Group members' comments tended to be broad and range from staffing needs, definitions, budget queries, modelling and tools, timing of tasks, roles and responsibilities, planning issues, software and data queries. The meeting minutes show researchers addressing the questions and queries of the Working Group members and making changes to Roadmaps in response.

However, as noted in section 3.1, some WPs struggled to engage meaningfully with members of the Working Groups due to absences from meetings and the level of representation in the Working Group meetings. Stakeholders presented mixed views as to the usefulness and impact of the Working Groups on influencing the research and the extent to which end users felt their views were heard and considered by WP researchers.

Some end users felt highly engaged by the researchers and were able to provide significant feedback on the research and input into the direction of the WP after it was established. This allowed the research to adapt to the changing needs of the end users. WP1 was considered to be particularly successful in co-designing research activities with end users. This is likely a result of WP1 actively translating the research into end user-focused products, for example, through FireTools. This has likely increased the visibility and perceived usefulness of the research to end users and supported their engagement. WP5 was considered to be successful in demonstrating flexibility in the design and delivery of the research in line with the needs of the Indigenous community.

For other stakeholders, some Working Groups did not engage well or significantly influence the research conducted by the WP. One example provided was that the end users moved to different roles, which impacted the continuity of the advice provided. Another stakeholder perceived that the meetings were an opportunity for researchers to present on the research, rather than have effective and constructive conversations about research translation.

In addition to the Working Groups, the Hub status reports show evidence of various informal meetings and discussions with research end users at conferences and workshops. Co-location occurred between one WP and its end users to build relationships and share insights and resources. Additional co-location could have been considered more broadly across the Hub and was planned between the Department and the UOW and Western Sydney University. However, this was delayed and made more challenging due to the COVID-19 pandemic restrictions.

4.1.3 Completion of projects

The WPs must submit final reports at the end of the WP that summarise the research undertaken and the outputs and outcomes produced. These are produced for the whole WP. These are to be approved by the Hub Steering Committee at the end of the Hub. However, under the WPs there is no formal process for completing or closing individual research activities or projects as they reach their culmination. While some WPs marked milestones and outcomes as complete in progress reporting, this has been inconsistent (see section 3.3.3).

Some stakeholders considered that endorsement of completed activities and projects under WPs was provided informally by end users through research translation, uptake of tools, and knowledge adoption. Research translation is further discussed in section 5.4.

Better signalling of the end of projects to end users would allow for a discussion with the Working Groups on how to disseminate the completed research and how to best reprioritise efforts, funding and other resources for new projects.

Key Finding 9 Work package co-design and co-delivery

The initial WPs were co-designed to some extent, although this was driven largely by the researchers.

Co-delivery of the WPs has largely been driven by the Working Groups, in part facilitated by some co-location of research staff.

The WPs did not have formal processes for completing projects, which would have prompted discussions about translation and resource allocation.

Source: ACIL Allen

4.2 Designing for priority needs

The evaluation plan considers the extent to which the Hub and WPs planned to address issues of equity associated with regional locations, high-climate risk areas or vulnerability.[34] The extent to which the Hub planned for these needs is considered below.

4.2.1 Targets that address vulnerable communities, sectors and regions

F.1 To what extent do the program targets treat vulnerable communities, sectors and regions equitably?

The program targets related to each KPI are presented in Table 3.1. Most of these targets do not specifically relate to vulnerable communities, sectors and regions. However, the WPs are generally focused on conducting research to inform and support decisions on bushfire management. This is most likely to benefit regions affected by fire, relative to those at a lower risk of fire. The extent to which the research addressed the needs of high-climate-risk areas and communities is discussed in section 4.2.3.

Of the targets that do relate tangentially to vulnerable communities, sectors and regions:

— The target for KPI 5, is *meeting OEH Knowledge Strategies, CCF Objectives or EBMP Objectives*. Vulnerable communities, sectors and regions are referenced in these strategies/objectives in terms of communities vulnerable to environmental pollution's health impacts (OEH Pollution Knowledge Strategy) and the need to create safer and more resilient communities (EBMP).

[34] In the evaluation plan, vulnerable refers to those are financially or socially vulnerable, for example due to poverty, limited control of their circumstances (including trade-exposed industries), resource constraints (such as regional councils where a climate event could affect a substantial proportion of the area), limited access to systems (such as culturally and linguistically diverse communities), amongst other reasons. Where the effect of fire events on these individuals, organisations and groups is disproportionately high, they may also be vulnerable.

— The targets for KPIs 6, 7, 8, 9, 15 and 16 relate to summarising and disseminating information to target groups and ensuring that target groups have access to, understand, and use the information. This allows the researchers to identify and meet the needs of target groups that may benefit from the research. Access and use of research outputs are discussed further in section 5.2.2.

As noted in section 3.3.2, the Hub's outcomes and objectives should inform the KPIs and targets, which should guide WP planning and activities. If research for priority groups is to be a focus for the Hub, this should be more clearly reflected in the KPIs and targets.

Key Finding 10 Targets that address vulnerable communities, sectors and regions

Most targets do not specifically relate to vulnerable communities, sectors and regions.

Better alignment of the Hub's outcomes and objectives with the KPIs and targets is needed to guide WP planning and activities in the future.

Source: ACIL Allen

4.2.2 Addressing regional issues

F.2 To what extent have regional issues been considered in identifying risks and opportunities, and developing tools?

Regional issues (i.e. variation in climate, fuel and moisture) have been considered as part of WP1 and WP2. They do not appear to have been considered explicitly as part of other WPs.

WP1 has focused on delivering key data to regional land managers to inform fire management planning (see Box 6.1).[35] WP1 has delivered the FireTools platform, which allows for consideration of NSW bioregions, and the Fire History and Smoke Tool (linked to WP3), which allows users to explore state bioregions and time periods, view burn maps (prescribed and unplanned), correlate fires with pollution, and calculate health impacts. WP1 is also modelling fuel moisture and climate trends across NSW regions to develop projections of fuel moisture thresholds under climate change scenarios.[36]

WP2 has focused on understanding landscape-level variations in fuels and fire behaviour and severity, including an assessment of the types, quantities, and moisture content of fuels across NSW's landscape.[37] This has involved using LiDAR-based[38] approaches to quantify the spatial profile of biomass and characterise the 3D structure of fuel.

Key Finding 11 Addressing regional issues

WP1 and WP2 address regional issues by exploring state-wide variation in climate, fuel and moisture.

Source: ACIL Allen

4.2.3 Addressing high-climate-risk areas and -communities

F.3 To what extent has the program targeted high-climate-risk areas and communities?

Researchers and end users commenting on this priority presented mixed views as to whether the WPs targeted high-climate-risk areas and communities. Some considered that this was inherent in

[35] UOW application

[36] Work Package 1 researchers (2021). *2021 Roadmap WP1_Final*. Sydney: NSW Government.

[37] NSW Bushfire Risk Management Research Hub (2021). *Fuel, Flammability, and Carbon Dynamics*. Op. cit.

[38] Light Detection and Ranging: a remote sensing technology that is used for surveying land and making digital 3-D representations of the earth's surface (among other applications).

the objectives of the Hub and WPs. The WPs have focused on the acceleration of climate change and the impact on the efficacy of fire treatment scenarios across NSW.

Two WPs have focused on high-climate-risk communities. WP3's research measures the impacts of smoke on human health to inform planned burning strategies that are most likely to reduce overall exposure to smoke, GHG emissions and exposure of people to air quality levels that are deleterious to human health.[39] Prior to the Hub's research, there was limited monitoring and understanding of the impact of smoke on health. This research may contribute to fire management practice and how to manage better the impacts on vulnerable people who are at a higher risk of poor health outcomes from smoke exposure.

WP5 focuses on cultural burning practices and Indigenous communities to develop understanding of how cultural engagement on fire and land knowledge and management is linked to well-being and resilience.[40] Some stakeholders considered that this WP closely aligned with the needs of high-climate-risk communities. The Blak Report, (currently being finalised), is considered by some stakeholders to be a significant achievement by WP5. The report is a first of its kind document that details the views of key cultural burning practitioners and the impacts of the 2019/20 Black Summer Bushfires on Indigenous communities, which was noted to be a high priority knowledge gap for NPWS and RFS.

The WP progress reports show that the WPs have delivered research findings through various channels, including peer-reviewed research articles, media engagement activities, conference talks, and outreach activities. This has focused on communicating the risks and community vulnerabilities related to climate change, including the link between climate change and the 2019-20 Black Summer Bushfires, the limits of post-fire vegetation recovery under climate change, and the impact of climate change on future planned burns and public health. The Hub's work on the Inquiry also resulted in the development of key reports that consider the impact of fire on vulnerable communities:

— *Demographic characteristics of populations affected by the 2019/2020 bushfires in NSW* - Josh Whittaker, Michael Bedward and Katharine Haynes
— *The social benefits of cultural burning* - Katharine Haynes
— *Smoke and human health* - Katharine Haynes and Nicolás Borchers Arriagada.

In contrast, some stakeholders noted that the researchers' consideration of high-climate-risk areas and communities was an afterthought and that more research was needed to address this outstanding gap.

Key Finding 12 Addressing high-climate-risk areas and -communities

All WPs have delivered research findings on the risks and community vulnerabilities related to climate change.

Some WPs have directly focused on research in high-climate-risk areas and communities, particularly WP3 and WP5.

Source: ACIL Allen

[39] NSW Government Office of Environment and Heritage (2017). *WP3 Project Plan Proposal*.

[40] NSW Bushfire Risk Management Research Hub (2021). *Indigenous Cultural Burning: Exploring the Links Between Cultural Revitalisation and Wellbeing*. Op. cit.

5 Delivery of the Hub

This chapter considers the Hub's outputs, how they have been accessed and used, and their usefulness and timeliness. It also examines how the Hub's partnerships and linkages have supported its research's communication and knowledge transfer.

5.1 Hub and WP progress

As part of this evaluation, ACIL Allen has considered the Hub's performance according to the status, milestones and outcomes set out in the WP-level progress reports and the Hub-level status reports.

5.1.1 Hub and WP status

Table 5.1 summarises the overall status of progress and status report indicators of scope, milestones, budget and outcomes. More detailed reporting is provided in Appendix A.5. According to the final WP progress reports and Hub status report,[41] the overall status of the Hub is 'on track' to deliver, with only one watchpoint on the indicator 'risk'. WP2 and WP5 are the only WPs entirely 'on track' across all indicators, while the remaining WPs have several watchpoints. Some of the reasons for these risks and issues noted in their respective final progress reports include:

- **WP1** (three watchpoints) – delays due to additional tasks not in the original work plan, risk assessment work needing to be completed, and the legacy of original underbudgeting for salaries
- **WP3** (three watchpoints) – delays and issues due to work on the Inquiry, unexpected challenges with modelling individual fires, the COVID-19 pandemic delaying fieldwork, and staff departures
- **WP4** (one watchpoint on 'milestones') - delays due to the demands for advice stemming from 2019-20 fires, and the COVID-19 pandemic delaying fieldwork
- **WP6** (three watchpoints) – issues with staff leave and departures has delayed milestone delivery, and a small overspend on budgeted salaries.

These risks are monitored by the Working Groups and Hub Steering Committee and will need to be managed if the Hub is to deliver according to revised timelines and on budget.

[41] The final WP quarterly progress report for February/March 2022 was not available for WP4. The August 2021 report has been used instead.

Table 5.1 Status of Hub and WP during final progress reporting

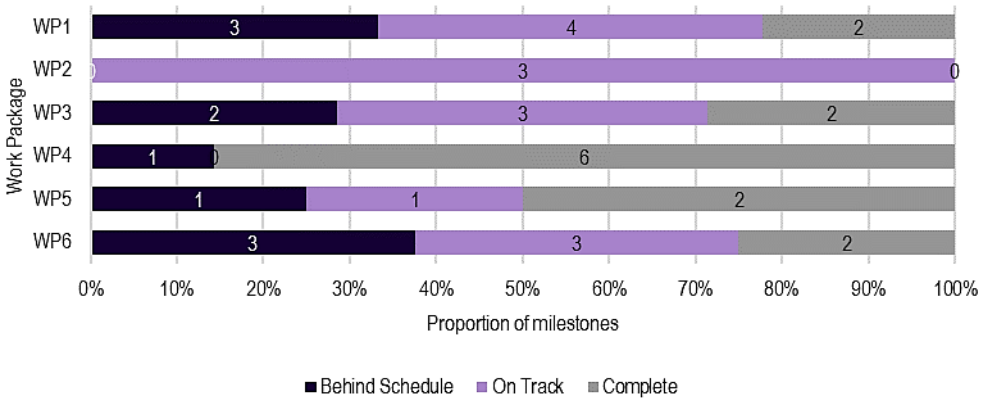
Hub/WP	Scope	Milestones	Budget	Outcomes	Risk
Hub	On Track	On Track	On Track	On Track	Watchpoint
WP1	On Track	Watchpoint	Watchpoint	On Track	Watchpoint
WP2	On Track	On Track	On Track	On Track	On Track
WP3	On Track	Watchpoint	Watchpoint	On Track	Watchpoint
WP4	On Track	Watchpoint	On Track	On Track	On Track
WP5	On Track	On Track	On Track	On Track	On Track
WP6	On Track	Watchpoint	Watchpoint	On Track	Watchpoint

Source: ACIL Allen, WP Quarterly Progress Reports February/March 2022 (WP1-3 and 5-6), WP Quarterly Progress Reports August 2021 (WP4), Hub Status Report March 2021

5.1.2 Hub and WP milestones and outcomes

Based on the most recent reporting on each milestone it appears that the majority of milestones are either complete or on track to be completed (74 per cent, 28 out of 38 milestones) (see Figure 5.1). WP2 has the highest (all work on track to be completed) and WP6 (63 per cent) the lowest proportion of milestones that are either completed or on track to be completed. It is reasonable that WP6 is delayed given it was designed as a capstone project that leveraged the findings from the other WPs to deliver a synthesising body of work on the costs, benefits and implications of managing fire risk. As such, any delays in activities from other WPs may impact on the delivery of WP6.

Figure 5.1 WP milestone status, at most recent reporting

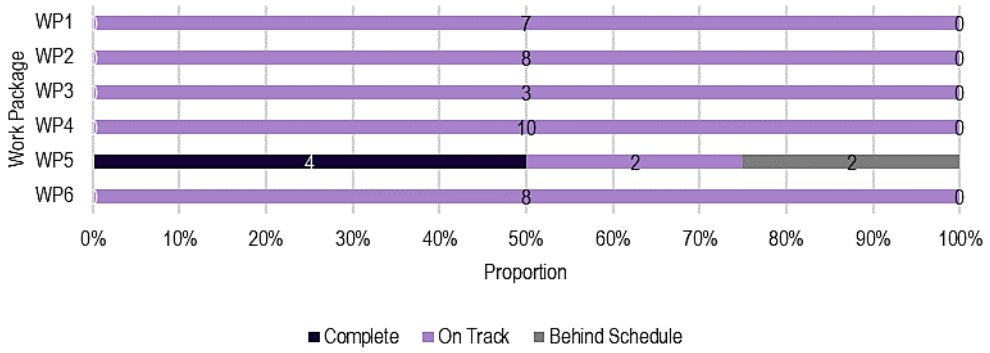


Source: ACIL Allen, WP quarterly progress reports 1-8

In terms of outcome achievement, the WPs appear to be on track to deliver their respective outcomes, at the time of the most recent reporting on each outcome (see Figure 5.2). Further details on each outcome and KPI reported by the WPs and Hub and the status of that KPI are provided in Appendix A.3.

However, with less than two months of the Hub's five year life left, all WPs have outstanding work to complete, and overall, only one WP has fully delivered more than 50 per cent of its work. Even with an extension of time until December 2022, it will be challenging for the WPs to conclude all outstanding work to a satisfactory degree.

Figure 5.2 WP outcome status, at most recent reporting



Source: ACIL Allen, WP quarterly progress reports 1-8

Key Finding 13 Status and progress reporting

While the WPs are 'on track' to deliver, there are some 'watchpoints' for 'risks', 'milestones' and 'budget' that may not be addressed before the Hub's completion. It will be challenging for the WPs to conclude all outstanding work to a satisfactory degree by the end of 2022.

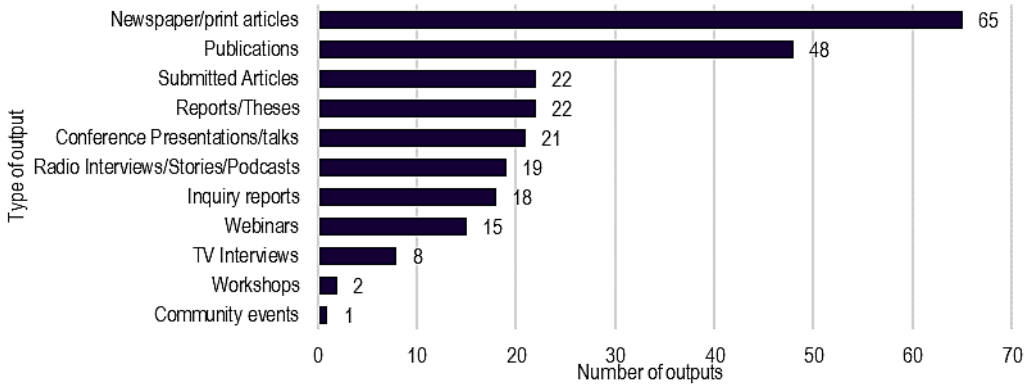
Source: ACIL Allen

5.2 Outputs delivered by the Hub

5.2.1 Outputs delivered by the Hub

The Hub has performed strongly in terms of the large range and number of outputs produced over the life of the Hub. It delivered 241 outputs across a range of categories, including print media, radio and TV, and academic reports, publications, presentations and workshops. Over a quarter of the outputs were in the form of 'newspaper/print articles' (65 outputs, 27 per cent), followed by 'publications' (48 outputs, 20 per cent), 'submitted articles' and 'reports/theses' (both 22 outputs, 9.1 per cent), and conference presentations (21 outputs, 8.7 per cent) (see Figure 5.3).

Figure 5.3 Outputs produced across the Hub by output category



Source: Hub Publication List

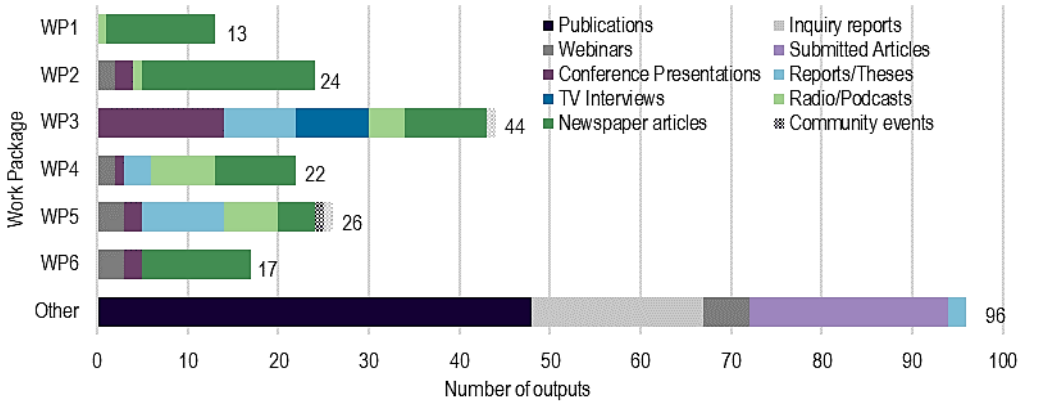
Most of the outputs are attributed to individual WPs, while some span multiple WPs or have not been attributed to a specific WP. Outputs not attributed to a specific WP, such as publications, submitted articles, and Inquiry reports, are identified as "Other" outputs. As shown in Figure 5.4,

leaving aside the 'Other' category, WP3 produced the most outputs (44 outputs, 18.3 per cent), followed by WP5 (26 outputs), WP2 (24 outputs), WP4 (22 outputs), WP6 (17 outputs), and WP1 (13 outputs).

Comparing the largest categories of output by WP shows that the 'newspaper/print articles' category comprises most of WP1 (92 per cent of outputs), WP2 (79 per cent) and WP6 (71 per cent), while WP3, WP4 and WP5 had a more diverse set of outputs. WP3 was unique in having around one-third of its outputs (or 14) as conference presentations and 12 TV or radio interviews. WP4 and WP5 were similarly diverse in their share of outputs.

General or 'Other' outputs from the Hub were predominantly in the form of academic publications (48 outputs), submitted articles (22 outputs), and Inquiry reports (19 outputs), plus some webinars and reports/theses. The 19 Inquiry reports refer to the Hub's contribution to the NSW Bushfire Inquiry (2020).

Figure 5.4 Outputs produced by category



Outputs relating to publications, inquiry reports, and submitted articles have not been specified by WP and are included in "Other" above.
Source: Hub Publication List

Key Finding 14 Outputs delivered by the Hub

The Hub has delivered an extensive range and number of outputs over its lifetime.
A total of 241 outputs were produced in many formats to meet the needs of a range of end users.

Source: ACIL Allen

B.1 To what extent were program outputs accessed and used by target end users?
B.2 To what extent were program outputs produced in the right form and in a timely fashion?

5.2.2 Access, use and timeliness of the outputs

End users

The end users for the Hub's outputs have been identified in WP progress reports, Hub status reports and Hub performance summary material. As overviewed in Table 5.2, the end users include government, land management agencies, research, industry and community stakeholders. The end users vary by WP according to the topic and the intended WP outputs, for example, WP4, which focuses on biodiversity and species conservation, includes end users and Working Group members from the North Queensland Threatened Species Symposium and the Australian Network for Plant Conservation. WP5, which focuses on cultural burning, includes end users and Working Group members from the Firesticks Alliance, Mullumbimby Firesticks and the Cultural Fire Management Unit at the Department.

Table 5.2 Summary of end users and partners

Work Package	Direct end users (i.e. users of outputs)	Broader end user groups (i.e. seminar or conference hosts)
WP1: Dynamic Mapping of Fire Regimes, Past, Present, and Future	NPWS (with FireTools used by NPWS fire planners to make decisions on planned burns and by branch fire team leaders to prepare for area meetings), the Department (e.g. risk assessment), RFS and Crown Lands (Natural Resources Services Unit)	Australasian Fire and Emergency Service Authorities Council (i.e. AFAC Seminar), other users of FireTools website
WP2: Fuel, Flammability, and Carbon Dynamics	RFS, NPWS (fire planners/ managers), and the Department use the fuel moisture mapping outputs	NPWS Annual Fire Managers Forum, RFS (Predictive Services Team & Fire Behaviour Analysts), FIRElinks & COST (a European Union network of scientists and practitioners involved in forest fire research, and the European Cooperation in Science and Technology (COST) funding agency)
WP3: Greenhouse Gasses, Particulate Emissions, and Air Quality	The Department, EPA and RFS and other agency staff	NPWS regional fire managers (South Coast, Metro and Central Coast), Firesticks groups (Nowra, Blue Mountains), The Department (Fire Incident Management Team), Natural Resources Commission, the Bushfire and Natural Hazards CRC, UOW (via the Jindaola grants program)
WP4: Fire Regime Guidelines for Conservation of Threatened Species	The Department, RFS, NPWS	WP4 developed outputs for broader community groups, e.g. Australasian Plant Conservation Bulletin, Nature Conservation Council Bushfire Conference, the Australian Network for Plant Conservation seminar series, and the NPWS Fire Forum
WP5: Health and Social Benefits of Indigenous Fire Management Programs	The Department (science division), RFS, NPWS, Indigenous communities and youth	The Department (Cultural Fire Management Unit), Firesticks Alliance, Bushfire and Natural Hazards CRC, Blue Mountains World Heritage Institute
WP6: Optimisation of Cost-Effective Bushfire Risk Mitigation	The Department (science division), NPWS, RFS	Australasian Fire and Emergency Service Authorities Council, broader community groups

Source: WP Progress Reports; Hub Status Reports; NSW Bushfire Risk Research Hub – Summary Report March 2022

Form of and access to the outputs

As discussed in section 5.2.1, the outputs are produced in various formats to encourage access and use by varied end users. For example, many of the Hub's outputs were newspaper/print articles, TV interviews and radio interviews/podcasts. These are typically publicly available and targeted toward public interest issues. This includes articles in the Conversation, ABC and Guardian, and interviews with ABC radio, Sydney Morning Herald, Sky News Australia, and the New York Times. Researchers have also participated in many community and outreach exercises, including Science Week activities, International Women's Day Climate Change Panel and Firesticks Alliance Presents event.

Academic publications and submitted articles also make up a significant proportion of the Hub's research, which is appropriate given the amount of new knowledge generated by researchers. These publications often lag research activities, and as such, further Hub research is expected to be published over the coming years. Publications tend to be developed for use by researchers and government policy makers. Some publications are not freely available through open access platforms or pre-paid publishing agreements that allow the articles to be freely downloaded. This limits the accessibility of the articles.

The Hub does not collect data on the access and use of most outputs. Third parties largely control this (e.g. access to academic journals is held by journal publishers, access to newspaper articles is held by individual media organisations, attendance at Science Week activities is monitored by

event organisers). Some exceptions are the FireTools (http://ft.bushfirehub.org/) website and an evaluation of the Hub Conference in 2019. Analysis of these outputs shows that:

- The first annual Hub Conference was held in mid-2019. It featured 23 speakers and attracted more than 250 fire managers, practitioners and researchers from government and community sectors. The conference evaluation report shows that of the 35 per cent of attendees that completed the end of conference survey, 97 per cent agreed or strongly agreed that they learnt something new, and 81 per cent had met new collaborators.
- FireTools has been used for 17,279 processing hours across 375 separate runs from August 2018 to February 2022. This does not include time spent planning for runs and discussing the findings in preparation for planned burns. The Department noted that every NPWS fire team leader had used the FireTools database. Every fire planner uses the data from FireTools before deciding on areas for planned burning. This has informed every planned burn conducted by NPWS since its launch in 2019 (see Box 6.1).
- Webinars published on the Inquiry themes also attracted a total of 1,124 viewers, and some Hub researchers are preparing academic papers on their contributions (i.e. WP3, WP4 and WP6):
  - Theme 1: Weather, fuel and dryness: how unusual was the 2019-20 fire season? 335 viewers
  - Theme 2: Fire severity, fire spread and lessons learned from the 2019-2020 fire season – 186 viewers
  - Theme 3a: People and Country: Human impacts of bushfire and the benefits of Indigenous cultural burning – 155 viewers
  - Theme 3b: Impacts of the 2019/20 fires on vegetation communities and threatened species – 189 viewers
  - Theme 4: Options for bushfire risk mitigation in the future – 259 viewers.

Usefulness and timeliness of the outputs

The key outputs that stakeholders most value include:

- FireTools (produced by WP1) was noted to be a significant technical piece or work that is actively being used and valued by NPWS and RFS to guide planning for fire-related land management activities. This leads to considerable time savings for land managers (see Box 6.1).
- Reports to the Bushfire Inquiry (produced by all WPs, including 29 researchers across the 19 reports). The Inquiry commissioned these reports as a 'deep dive' into particular research questions to inform the nature of the 2019-20 season and address current knowledge gaps. These reports were considered to have made a significant and timely contribution to the Inquiry, addressing major knowledge gaps relating to droughts, fuel dynamics, and the social and environmental impacts of the fires. It influenced many of the Inquiry recommendations and set the future direction for fire management.[42]
  As a result of this contribution, the Hub was awarded the prestigious 2021 Eureka Prize for Applied Environmental Research.
- Flora and Fauna Fire Response database (produced by WP4) houses new and higher quality information generated by the WP and the Department. This will inform Departmental decision making on fire management while considering biodiversity conservation.

[42] Australian Museum (2021). *2021 Australian Museum Eureka Prize winners*. Accessed 22 April 2022: https://australian.museum/get-involved/eureka-prizes/2021-eureka-prizes-winners/#enviro-research.

— Cultural burning outputs delivered by WP5 include a Cultural Burning immersive Aboriginal Youth workshop, the Cultural Burning for Resilience documentary (presented as a case example in Box 6.2), and the Blak Report.

Some of the other WP outputs have been slower to emerge, with ongoing research, integration and synthesis under way for several of the WPs. These delays have been largely unavoidable, for example, due to the impacts of the COVID-19 pandemic, reprioritisation of efforts to focus on the Inquiry, unforeseen need for additional data collection, and staffing issues (recruiting, absences and relocations). It is worth noting that much of the research to date has been building foundational knowledge that is only now being integrated into end user tools and products.

In particular, WP6, which was designed as a capstone, or synthesis piece of work, integrates research conducted by other WPs to facilitate the use of the results. This will be in the form of a tool that will provide data driven insight to inform policy and operational decision making to optimise all levels of bushfire management. The tool will position NSW at the forefront of bushfire management nationally and is one of the key outputs sought by the Department. This is set to be completed in December 2022.

Another issue relating to delivery was the level of visibility given to end users on the format in which some of the research would be delivered. For example, while foundational knowledge is essential for building further outputs, policy makers and operational fire managers will likely benefit from research findings in summary format, operational guidelines and advice rather than in an academic journal. While some stakeholders were currently developing these outputs for selected WP's research outputs, this was considered an afterthought to several stakeholders.

Key Finding 15 Access, use and timeliness of the outputs

The broad range of end users involved in the Hub align with the intent of the Hub and WPs.

The outputs are produced in various formats to encourage access and use by varied end users. However, more work is needed to ensure all outputs are produced in formats that encourage access.

The Hub does not collect data on the access and use of most outputs, which third parties largely control. The first annual Hub Conference, Hub website, and FireTools website show strong usage.

Key outputs (e.g. FireTools, Inquiry reports and cultural burning) have delivered high value to end users.

Other WP outputs have been slow to emerge, and end users do not always have visibility of the outputs or how the research will be translated.

Source: ACIL Allen

D.2 To what extent were partnerships / linkages between institutions / organisations encouraged and supported? Which partnerships / linkages were established? Which partnerships / linkages can be considered sustainable?

5.3 Partnerships and linkages across the Hub

Hub partners

As discussed in section 2.2.1, the RFT documentation recognised that a consortia arrangement was most likely needed to amass the necessary experience and expertise to deliver on the Department's requirements for the research. By design, the Hub and spoke model brought together existing and new partners to deliver the Hub collaboratively. As such, ACIL Allen believes that the decision to develop a Hub based on a relational model (as opposed to a transactional model) is sound and provides solid foundations for an effective initiative.

The UOW, as the Hub Host, coordinated the development of the RFT response and later the Hub across the four universities. The arrangement was built on existing collaborations (often decades in the making) of renowned and world-leading experts. According to one stakeholder consulted for the evaluation, the selection of partners with existing solid working relationships helped reduce the delivery risks of the Hub.

While additional researchers could have been initially included in the Hub, there were natural limits (i.e. budget envelope and the timeframes for delivery) to the number of research partners who could be involved effectively in the Hub's delivery.

That said, the Hub became more collaborative over time with new end users and members brought in to address specific needs. The new 'supporting members' that were added to the Hub contributed resources (e.g. funding, personnel, facilities, co-supervision of students) and expertise to help expand research projects within WPs (e.g. a new ARC linkage or other collaborative research grants and PhD student scholarships). They also helped to develop new projects that filled a gap in the Hub's research effort. Supporting members added to the Hub include Australian National University (connected to WP2), University of Melbourne (WP6) and La Trobe University (WP4).

The partners were generally satisfied with the partnership arrangements and considered it a natural collaboration led by the UOW. Stakeholders also considered the partnership selection to be appropriate for the research to be undertaken by each WP.

The Hub and government

The Hub has worked closely with the Department and NSW Government agencies responsible for bushfire and land management, including NPWS and RFS. This has been a consistent theme of the feedback provided by stakeholders who were consulted for the evaluation.

The Hub Steering Committee, Working Groups and Knowledge Exchange Officer have been the main interaction points between stakeholders. These arrangements established new partnerships and linkages between some researchers and end users and facilitated ongoing engagement to guide the research activities and outputs. This is evidenced by the ongoing addition of researchers (see below and section 4.1.2), supporting members (see section 5.3) and end users (see section 5.2.2).

Hub participants considered that the Working Group meetings facilitated regular informal communications and collaboration outside of the structured Hub Steering Committee meetings. Stakeholders were generally satisfied that the correct participants (i.e. universities and experts) were involved in the Hub. As a result, the Hub facilitated the Government's access to expert advice. This was considered to provide additional benefit compared to those arising from the outputs of the research alone.

The Hub commissioned a Social Network Analysis Report[43] to analyse the Hub's social networks. This report assessed the connection between individuals, cohesion, diffusion channels, and the Knowledge Exchange Officer role. A total of 68 Hub members were identified and were asked to complete a survey three times between 2018 and 2019. Members were categorised by their relevant WP and into agency categories (i.e. Department staff involved in operations, science, NPWS, RFS; university; other; Knowledge Exchange Officer). The analysis found that the regular WP and Working Group meetings contributed to the development of the network structure, and cohesion grew over time.

The Social Network Analysis Report also found that peripheral nodes (i.e. a range of PhD and post-doctoral students) and agency members became more connected with established researchers as they were embedded in their WP. Further, the average degree and density of interactions across the network and the interactions and cohesion across the nodes increased over

[43] Cunningham, R; Adams, M; Goggin, C.L. (2019). *Exploring networks of the New South Wales. Government Bushfire Risk Management Research Hub*. Sydney: University of Technology Sydney- Institute for Sustainable Futures and the Department of Planning, Industry and Environment.

time. The final finding was that the network structure is not developing by chance, as the network is regularly growing over time.

> *The findings demonstrated that the network structure developed in a way that could not have happened by chance, but rather may be due to the nature of the interaction of the work package meetings happening at regular intervals, the engagement of the singular knowledge broker [Knowledge Exchange Officer] across the network, and /or the engagement of key players (who are also Hub leaders) across work packages. Further, the network grew in cohesion over time across the work packages with both the knowledge broker and hub leaders playing bridging roles across the network.*[44]

This analysis was confirmed and is consistent with the stakeholder views.

Sustainability

As the Hub has progressed toward the end of its funding cycle, contract and funding uncertainty has led a number of the Hub's researchers to prematurely leave for other roles. The Hub Director also retired at the end of 2020 (this was not anticipated or foreseen at the time of his appointment when the Hub was formed). These roles were replaced by new staff or absorbed into the workload of existing participants. Further, end users have also moved on to different roles and discontinued their roles in the Working Groups.

These researchers have generally moved to research roles at other universities, government or industry organisations. Some have continued to conduct related research and contribute to the Hub (i.e., drawing on funding from other sources such as ARC Linkage Grants, which have supported research related to Hub activities).

These departures have created significant challenges with continuity, loss of institutional memory, transitions for new staff, delays in achieving WP milestones and outcomes, and risks to the completion of the research projects.

Many stakeholders considered that these risks were not adequately planned for by individual WPs or at a more strategic level by the Hub Steering Committee (see section 3.1). Stakeholders suggested that greater clarity and planning for the end of Hub life may have helped mitigate these risks.

Key Finding 16 Partnerships and linkages across the Hub

The Hub was built on existing partnerships and relationships, which have matured over time. The Hub Steering Committee, Working Groups and Knowledge Exchange Officer have been key interaction points between the researchers and end users and have played important roles in fostering these relationships and partnerships.

The end of Hub life has created contract and funding uncertainty that has led key Hub members to leave prematurely. These risks were not adequately planned for and have caused significant challenges to the completion of WPs and the delivery of research.

Source: ACIL Allen

5.4 Communication and knowledge delivery

5.4.1 Design of the Hub's communication and knowledge delivery mechanisms

A.3 How appropriate were the knowledge delivery mechanisms?

The Hub's Communications Strategy outlines the process for developing communication plans and guiding communication activities. It aims to enable effective communication that is consultative,

[44] Ibid.

easily understood, and underpins teamwork within the Hub and communication with relevant stakeholders.

The Department first developed the Communications Strategy in November 2017. Approval was originally planned for April 2018 but was delayed to allow for receipt and implementation of advice from communication experts in the Department, NPWS and UOW.[45] UOW subsequently redrafted the Strategy before it was approved by the Steering Committee in March 2019, more than a year after the Hub commenced.[46]

The Communications Strategy outlines an approach that provides a continuous flow of content among Hub participants and between the Hub and the public. This recognises the high public interest in the Hub outputs and the need to streamline access to this information for public use.[47]

The Communications Strategy outlines three principles of communication: clarity, consistency, and leadership. These are designed to promote expert analysis to allow for constructive feedback from stakeholders. Communication tools that are created following these principles should focus on:

— positioning of the Hub as the centre of applied bushfire science in Australia
— fostering collaboration between research and risk management
— influencing management policy and operational decision-making
— raising awareness of the changing risks posed to stakeholders.

The Communications Strategy outlines how these principles should be implemented to communicate to a wide audience, aligning with the program goals: increasing research capability and investment, establishing partnerships and knowledge and improving public understanding of bushfire risks and management.

The Communications Strategy identifies the Hub stakeholders, their relationship to the Hub, communication areas, and how they can support the Hub. The stakeholders include Hub members and affiliates (i.e. universities, the Department, NPWS and RFS), fire services personnel (professional and volunteers), land managers and planners (e.g. Councils, Planning Department, NPWS), residents in high-risk areas (i.e. on the urban fringe), Government (i.e. Ministers and Members of Parliament) and the scientific community.

The stakeholder engagement component of the Communications Strategy details specific stakeholder engagement activities (e.g. internal briefings, annual conferences, research publications, co-location of staff, newsletters, workshops) and responsibilities for approving these:

— Hub Project Team: responsible for implementing the Communications Strategy.
— Hub Director: has multiple communication responsibilities to government agencies, state government Ministers, community groups, local Aboriginal Land Councils, and local councils.
— WP leaders: responsible for communication with universities, government agencies, and Aboriginal Land Councils.
— UOW government relations team: formally briefs the Premier of NSW.
— Researchers: drive communication with the scientific community (e.g. through publications and attendance at conferences).

[45] Bushfire Risk Management Research Hub (2018). *Project Status Report 1 January 2018-31 March 2018*. Sydney: Office of Environment and Heritage.

[46] Bushfire Risk Management Research Hub (2019). *Project Status Report 1 January 2019-31 March 2019*. Sydney: Office of Environment and Heritage.

[47] Bushfire Risk Management Research Hub (n.d.). *Communications Strategy Bushfire Risk Management Research Hub*. Wollongong: University of Wollongong.

The Hub has a communications strategy which is segmented, detailed and well thought through. It should have provided the grounds for effective knowledge delivery and translation to have occurred, but for the range of reasons outlined in Chapter 3 Hub communications did not reach its fullest potential.

5.4.2 Delivery of communications and knowledge

In practice, communication and knowledge have been delivered by many key stakeholders and channels, including the Knowledge Exchange Officer broadly connecting with Hub participants and end users; researchers engaging with each other, end users and the broader public; and the Hub governance structures engaging with researchers and strategic and operational end users.

Communication and knowledge delivery have been guided by the Communications Strategy, which is frequently referenced in Hub status reports, particularly as it relates to approval of communications activities from the Hub Steering Committee.

The Knowledge Exchange Officer role was designed to provide a bridge between the Hub's research and its network of end users and partners. The Social Network Analysis Report[48] demonstrates that as the Hub progressed and the Knowledge Exchange Office role developed, the intensity of the interactions increased between WPs and between the Knowledge Exchange Office and other Hub stakeholders.[49] Some stakeholders consulted for this evaluation confirmed that communications improved over the life of the Hub and that the Knowledge Exchange Officer was essential in connecting stakeholders and supporting knowledge sharing. Other stakeholders considered that there could have been more communication, and that the Hub did not communicate as extensively as other research models they had been involved in (i.e. CRCs).[50]

The report also shows that key individuals in the Hub have long standing relationships. This is often due to working across multiple WPs, in multiple government agencies across their careers or through geographical co-location. It is logical that more frequent, and longer-term interactions among stakeholders will likely lead to greater communication and knowledge sharing. These relationships are expected to continue to grow well after the Hub's work has been completed.

As overviewed in section 5.1, the Hub delivered an extensive range of outputs through mixed media approaches, including written, in-person, audio and audio-visual media. While the citational impact or viewership of this media communication has not been measured, it is likely that the Hub's work has been drawn on by many more stakeholders and community members than have been discussed in this report.

Stakeholder perspectives

Some stakeholders noted that the Hub lacked a practical communications plan (despite a strategy), a dedicated communications officer/science translator and resources to deliver on the plan. As such, communications tended to rely on university resources (i.e. funding and communications officers), with some activities funded from the Hub budget.

Communications were primarily and deliberately delivered through relationships between researchers and end users. Working Groups and Hub Steering Committee members were seen to help bring people together to improve communication and knowledge sharing with their

[48] Cunningham, R; Adams, M; Goggin, C.L. (2019). Op cit.

[49] The Social Network Analysis Report does not comment on the intensity of interaction that is standard or would be useful in such research models.

[50] Other research bodies (such as CRCs) have significantly more funds allocated to support communication and knowledge sharing. We acknowledge that a different and larger funding allocation would be required for the Hub to undertake these activities at a more significant scale.

organisations. They were the key mechanisms used for facilitating information exchange between the Hub and its stakeholders.

Some stakeholders considered that the communications could have been more effective. They considered that a dedicated and coordinated effort was required to drive effective engagement with end user organisations and ensure relevant end users took up hub knowledge. This includes stronger dissemination by the Hub Steering Committee and Working Groups and more effective Knowledge Exchange Officer role resourcing (see section 3.2).

Further, while stakeholders generally agreed that end users were embedded in the design and delivery of the research, stakeholders acknowledged that the Hub and end users did not adequately plan how the research would be translated into policy and operations or more broadly disseminated.

Several stakeholders noted that this translation function needed to be better planned and resourced (see section 3.2). Some stakeholders considered this could be achieved through better resourcing of the Hub's knowledge management function (i.e. two full time employees dedicated to knowledge management) or through additional knowledge management roles in key agencies, such as NPWS and RFS. This would allow the Knowledge Exchange Officer to work with their counterpart in key agencies to ensure end users knew the knowledge and tools generated by the Hub and could access and use these. However, these stakeholders also acknowledge that the budget was limited and that additional funding and end user commitment would have been required to deliver enhanced information exchange outcomes from the Hub.

Key Finding 17 Delivery of communications and knowledge

The Hub has a Communications Strategy which outlines the process for developing and guiding Hub's communication plans and activities. It is segmented, detailed and well thought through, and it should have provided the grounds for effective knowledge delivery and translation to have occurred.

Despite the presence of a Communications Strategy, communications and knowledge delivery have not fully met the expectations of some stakeholders. There are opportunities to improve delivery and consider the process and structural dimensions of research translation to ensure they are more effective/impactful. To order capitalise on these opportunities, additional resources will be needed to support enhanced information and knowledge exchange in the future.

Source: ACIL Allen

6 Impact of the Hub

This chapter considers the Hub's impact on agencies' policies and planning activities. It also explores the Hub's environmental, financial and wider (unintended) impacts and legacy.

6.1 Impact of the Hub on policies and planning

C.1 To what extent are policies and planning requirements informed by information, knowledge and tools produced?

Stakeholders reflecting on the design of the Hub (see section 2.2) noted that it was able to deliver a critical mass of bushfire research and impact that could not have been achieved through individual contracts or by existing research bodies/arrangements. As one stakeholder noted, "*the whole is greater than the sum of its parts*".

The impacts of this research on Department, NPWS and RFS policies and planning are diverse, longer-term, tangible and intangible. They are likely to lag the research outputs as it takes time for research to be understood and translated into practice. This section considers some of the prominent impacts observed to date.

FireTools

As overviewed in section 5.2.2, FireTools has been impactful due to its extensive use by NPWS fire team leaders and fire planners to guide NPWS planned burns and hazard reduction regimes. FireTools is overviewed in the case example in Box 6.1.

Box 6.1 Case example: FireTools

A key objective of WP1 was to develop a novel method for the automated measurement and monitoring of fire regimes through ingesting multiple data streams, which were to be processed and stored in a searchable geographic information (GIS) database.

This aimed to deliver an innovative approach to mapping fire extent, pattern, intensity and severity and cataloguing this information in a dynamic fire regime database. This was to inform research and management decisions with support tools. One of these tools, FireTools, is a dynamic fire regime GIS database and embedded software platform.

FireTools uses historical fire and vegetation data, mapping tools, and expert analysis to understand intensity, severity, spread, return interval, and smoke dispersion patterns and how climate change affects these factors over time. FireTools aims to build an understanding of fire return intervals across NSW ecosystems, the drivers of extreme fire behaviour in the past and future, and trade-offs in emissions from planned burns and wildfires. This will support behavioural modelling of fires and climate trends and allow retrospective evaluation of the impact and scale of specific fires.[51]

FireTools aims to transform pyrogeographic research capabilities and enable fire managers to improve risk management by providing the first sub-continental scale understanding of the biophysical drivers of individual fires and the emergence of fire regimes.[52]

FireTools has delivered eight publications, contributed to the Hub's support for the NSW Bushfire Inquiry and the winning the Eureka Prize for Applied Environmental Research awarded by the independent Australia Museum (see Box 6.3),[53] and a webinar on the benefits and future directions of FireTools (including applicability to other jurisdictions).

According to the Department, FireTools is used by every NPWS fire team leader and FireTools data is used by every NPWS fire planner to inform every planned burn conducted by NPWS since the cloud-based model was launched in 2019. FireTools has been used for 17,279 processing hours across 375 separate runs from August 2018 to February 2022.

Source: ACIL Allen, various

Cultural burning research

WP5's cultural burning research has focused on understanding how cultural engagement is linked to well-being and resilience about fire and land knowledge and management.[54] WP5 has delivered a range of cultural activities in line with this research, including an immersive cultural burning workshop for Indigenous youth and extensive engagement with cultural burning practitioners.

This work has resulted in the development of a documentary on the Indigenous youth workshop titled *Cultural Burning for Resilience* (see Box 6.2). It has also been used in submissions to the 2021 State of the Environment Report, the Inquiry, Firesticks Alliance's submission to the Royal Commission into Natural Disaster arrangements, the development of the Blak Report and sponsorship of the 2018 National Indigenous Fire Workshop (attended by 382 people from across Australia).

[51] NSW Bushfire Risk Management Research Hub (2021). *Dynamic mapping of fire regimes, past, present, and future*. Op. cit.

[52] Ibid.

[53] Australian Museum (2021). Op. cit.

[54] NSW Bushfire Risk Management Research Hub (2021). *Indigenous Cultural Burning*. Op. cit.

Box 6.2 Case example: Cultural Burning for Resilience Documentary

WP5's action research project explored the power of an immersive cultural burning workshop to increase cultural connection and wellbeing in Aboriginal Youth. This involved active participation in a cultural burn over two days.

Young Aboriginal emerging leaders facilitated the three-day, overnight workshop on Murramarang Country (Yuin Nation) in June of 2021. The local Elders mentored the emerging leaders, who mentored the 23 Aboriginal boys and girls aged 14-17 who engaged in the workshop. This process allowed for two layers of mentorship.

Aboriginal Elders and the wider community collaborated to deliver the workshop. The community included the Ulladulla Local Aboriginal Land Council, local Yuin cultural fire practitioners; researchers from the UOW, Treading Lightly Inc.; and Mane Collective Video Production. The students came from local high schools (Bomaderry, Nowra, Ulladulla and Batemans Bay).

Researchers analysed the digital stories and semi-structured qualitative interviews with the youth, teachers, and workshop facilitators. This showed that cultural burning provides a clear pathway for Aboriginal youth to connect with culture and Country.

The workshop generated several outcomes and impacts, including an important role in:

- empowering and engendering long-term resilience in Aboriginal youth
- mentoring emerging leaders and young participants
- developing a youth-led transformative learning process
- building the capacity of and empowering Aboriginal young people to lead and have a voice
- increasing non-Indigenous peoples' understanding of Indigenous ways of connecting to culture and Country and caring for Country for social and environmental justice.

This has clear links to land and fire management using Aboriginal knowledge and cultural practices.

The workshop also compiled powerful digital stories on youths' journeys, the "*Cultural Burning for Resilience | The Mini-Documentary"*. This was published online (via vimeo) by Mane Collective Video Production. As of April 2022, the documentary had 280 views. It was presented at an exhibition hosted by the Australian Museum in Sydney and promoted through a screening workshop and via social media. The documentary is available on the UOW's website.

Source: Haynes, K et al. (2022). Cultural Burning for Resilience: An immersive Aboriginal Youth workshop notes; Cultural Burning for Resilience | The Mini-Documentary (2021). Available at: https://vimeo.com/603712505/d8549a8fdf

NSW Bushfire Inquiry

C.2 To what extent has the information been used by end users outside the original target group?

The Hub was established in 2017, in advance of the 2019/20 Black Summer Bushfires and Inquiry. The Hub's significant contribution to the Inquiry generated positive impacts for the NSW Government, the public, and many other stakeholders beyond the original target group and planned research. This is overviewed in the case example in Box 6.3.

The NSW Government accepted all 76 recommendations from the Inquiry. The Hub's contribution significantly impacted the way the NSW Government has planned for bushfires following the 2019/20 Black Summer Bushfires.[55] This includes additional funding for bushfire research and technology development and commercialisation and potential changes to planning, vegetation management, and potentially, for legal liability for fire prevention and management.[56]

Box 6.3 Case example: NSW Bushfire Inquiry

The NSW Premier announced an inquiry into the 2019-20 bushfire season in January 2020 to recommend the causes of, preparedness for and response to the bushfires. A report was delivered by July 2020, in advance of the 2020-21 bushfire season.

The purpose of the Inquiry was to identify the critical lessons from the 2019-20 season and to understand and address the current knowledge gaps in bushfire research.

The Hub was commissioned to deliver 19 projects for the Inquiry. The 19 projects completed by the Hub aligned with different WPs and expertise. For example, fuel dryness and hazards (WP2 related); fire weather, spread, and severity statistics (WP1 related), smoke and human health (WP3 related); probability of house destruction, demographic characteristics of populations affected (WP5 related); and impact of priority NSW flora, and ecosystems impacts (WP4 related).

As the bushfires occurred after the Hub commenced, the Hub had not planned to contribute to the Inquiry. The Hub reprioritised its work to commit researchers' time and resources to the projects. This diverted efforts away from Hub milestones and outputs, which were later compensated for with additional funding provided to the Hub and revision of the Hub timeframes.

The Hub enabled a collaboration of the best researchers in the country to mobilise and deliver a rapid and targeted response quickly. The consensus among Hub stakeholders was that the Hub made a significant contribution to the Inquiry, including the analysis, advice and recommendations that ensured the Inquiry had actionable and evidence-based information to inform recommendations and government policy. For some stakeholders, this effort was sufficient to justify the establishment of the Hub.

> *"The work on the Inquiry reports was incredible. This build strong agency trust to seek advice and direction for the Inquiry" – Department stakeholder*

As a result of its invaluable contribution to the Inquiry, the Hub was awarded the Eureka Prize for Applied Environmental Research awarded by the independent Australia Museum.[57]

Source: ACIL Allen, various

The research has also likely been disseminated more widely and attracted more national and international interest due to the severity and intensity of the 2019-20 Black Summer Bushfires. The Hub's work on these bushfires resulted in significant media attention and contributions by Hub researchers at the time of the fires. This work contributed to the global discussion on climate change and likely led to greater engagement with the general public, researchers and policy makers than originally anticipated.

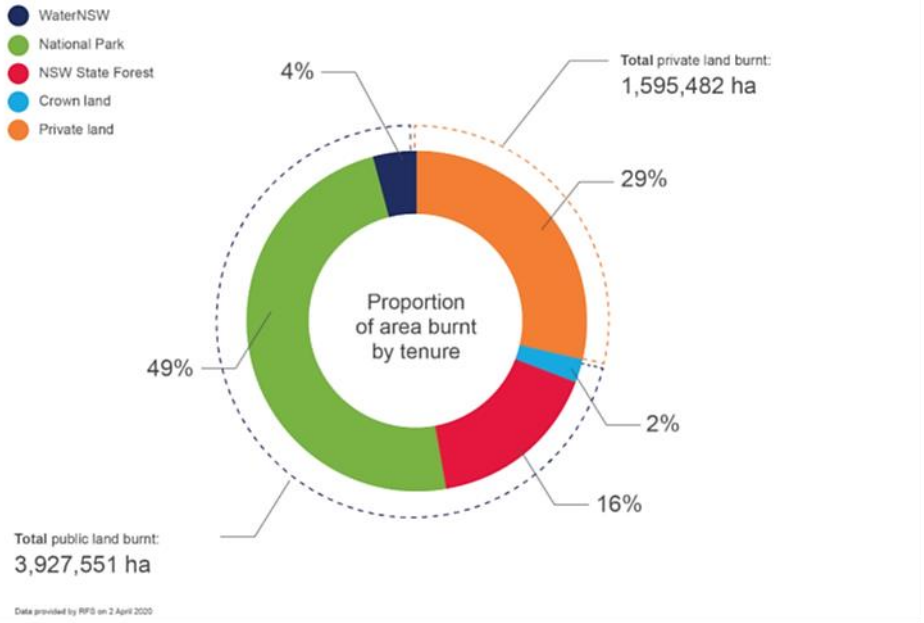
Data from the NSW Bushfire Inquiry (shown in Figure 6.1) details the area burned in the 2019-20 bushfires by land tenure. The fires burned across both public and privately-owned land with no regard for tenure boundaries. While a significant proportion of the national parks estate was impacted, a greater proportion of the Forestry Corporation of NSW estate was burned (albeit the total area burnt was less).

[55] Carmody, J. (2020). *NSW Government accepts all 76 bushfire inquiry recommendations*. Accessed 25 April 2022: https://www.abc.net.au/news/2020-08-25/nsw-government-to-accept-all-bushfire-inquiry-recommendations/12592164.

[56] Carrigan, D. & Studdert, J. (2020). *NSW Bushfire Inquiry calls for greater operational capacity and planning to prevent and respond to bushfire risks*. Sydney: Clude & Co.

[57] Australian Museum (2021). Op. cit.

Figure 6.1 Proportion of area burnt by tenure - 2019-2020 bushfires



Source: NSW Bushfire Inquiry, page 28

While there were benefits from building the Hub around pre-existing collaborative structures and focusing on the specific issues facing the Department, NPWS and RFS, there was an opportunity to broaden its reach. A number of the key outcomes/outputs for the Hub (and associated KPIs) emphasise the need for state-wide considerations and application – reflecting that bushfires and their impact will be felt across contiguous areas.

That said, many of the Hub's outputs only extend to these artificial (from an environmental perspective) boundaries. For instance, FireTools mapping stops at the NPWS and Forestry Corporation interface even though fire risk, impact and hazard is essentially continuous. There is also an opportunity to better incorporate Aboriginal land management and knowledge holders and their approaches to fire management, in the design, delivery and translation of the research (notwithstanding WP5's focus on cultural burning).

The Hub could have had a greater impact across NSW if land managers outside of the Department, NPWS and RFS were better engaged and embedded in the Hub's Working Groups and as end users. This includes the Forestry Corporation (with responsibility for more than two million hectares of State forests[58]) and WaterNSW, both of which manage areas that are generally contiguous with the NPWS estate. However, such collaboration will only deliver strong outcomes if there is full commitment and buy-in from all parties (we understand from stakeholder comments that such an approach was explored but not fully pursued).

[58] Forestry Corporation (n.d.). *Welcome to Forestry Corporation of NSW*. Accessed 22 April 2022: https://www.forestrycorporation.com.au/.

Key Finding 18 Impact on policies and planning

The impacts of the Hub on Department, NPWS and RFS are varied.

The Government gained significant benefit from having a highly experienced and coordinated group of researchers to provide rapid support during the Bushfire Inquiry. Much of the insight generated from the Inquiry has supported planning and bushfire management across Government. The work on FireTools and the Cultural Burning was also valued by stakeholders for its contribution to policy and operations.

In some instances, the research outputs are yet to reach the hands of policy and operational officers within Government. The impact of these outputs is likely to be felt in the years to come.

The impact of the Hub could have been wider if other NSW land management agencies were better engaged and embedded in the Hub's Working Groups and as end users.

Source: ACIL Allen

6.2 Impact of the Hub on the environment

C.3 To what extent has the program achieved positive changes in the environment?

The Hub indirectly impacts the environment by providing the evidence base to inform policies, guidelines, practices and education and training. Of relevance to the environment, researchers have focused on developing optimal planned burning approaches, defining planned burning strategies that have the least impact on air quality and threatened biodiversity, and improving the ability of fire managers to mitigate GHGs and protect carbon stock.

Optimal planned burning approaches

FireTools can inform ecological priorities for fire and land management that focus on maintaining biodiversity and reducing the impact of environmental fire. Working with NPWS has enabled this tool to be integrated into NPWS operation, broadly disseminated and adopted by end users for use in fire management planning (see Box 6.1).

Planned burning strategies with the least impact on air quality and threatened biodiversity

WP3's work on smoke and air quality has resulted in recent publication of two major research papers on fuel consumption in hazard reduction burns and smoke dispersal from hazard reduction burns using low-cost monitors. The WP is preparing two other papers on the smoke signal from historical fires about predicting smoke exposure from individual fires and daily exposure to smoke across the Sydney basin. Over the remaining time, WP3 expects to complete additional research to estimate the average impact of hazard reduction burns and bushfires and compare prescribed burning strategies. This will involve the simulation of hazard reduction scenarios. This smoke and GHG work will be integrated into WP6's optimisation modelling.

WP4's work on biodiversity has resulted in a new Fauna Fire Response Database, which may be integrated with BioNet, the Department's repository for biodiversity data products. WP4 is also progressing research on the impacts of fire seasons, resprouting success, interval squeeze,[59] and high severity fires.

[59] Interval squeeze refers to the simultaneous increase in the time taken for plants to recover post-fire and reduction in the time between fire events. This results from climate-change-induced conditions (i.e. prolonged drought, heat waves, and extreme fire weather).
Le Breton, T. D., Lyons, M. B., Nolan, R. H., Penman, T., Williamson, G. J., & Ooi, M. K. (2022). Megafire-induced interval squeeze threatens vegetation at landscape scales. *Frontiers in Ecology and the Environment*.

Fire managers' ability to mitigate GHGs and protect carbon stock

WP2 is in the process of surveying a burn study site in Eden, NSW. The survey will assess trees burnt by the 2019-20 Black Summer Bushfires to estimate tree mortality, carbon release, soil carbon storage and shrub recovery. This will build an understanding of the GHGs released during bushfire events and the amount of carbon stored in the soils.

Key Finding 19 Impact of the Hub on the environment

The Hub indirectly impacts the environment by providing the evidence base to inform policies, guidelines, practices and education and training.

The WPs deliver a range of research outputs that will inform planned burning best aligned with environmental priorities.

Source: ACIL Allen

6.3 Financial impacts of the Hub

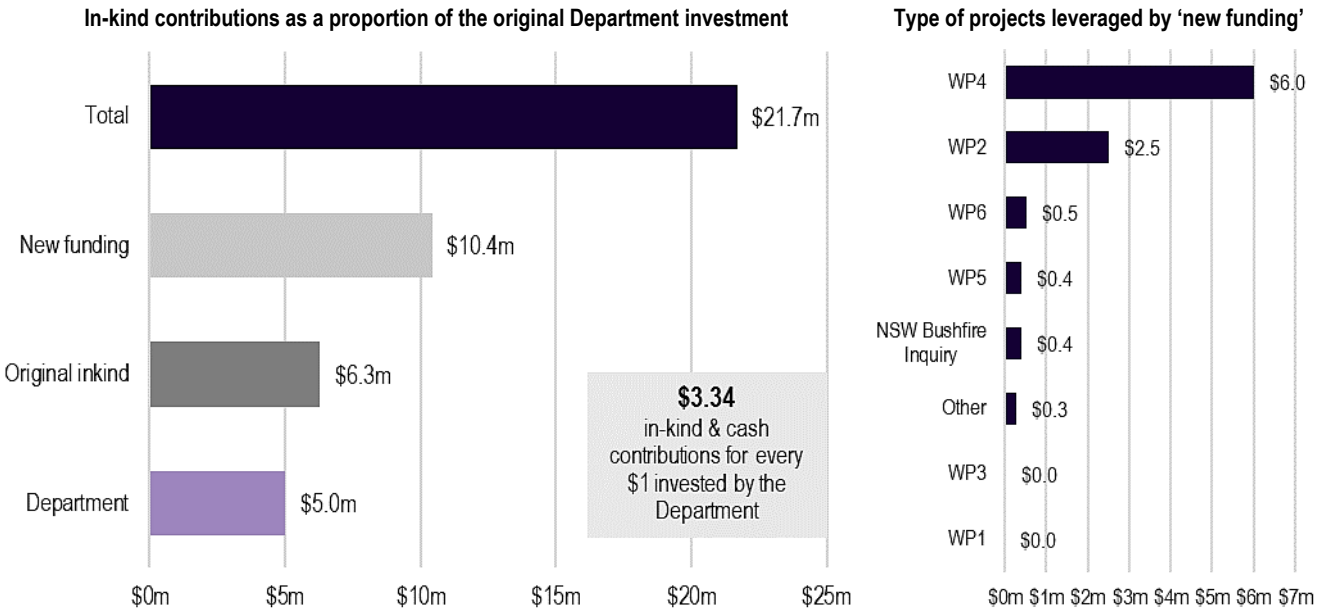
D.1 To what extent has the program been able to leverage additional resources (cash and in-kind contributions)?

The Hub initially received $5 million in funding (over five years) from the Department. This was considered a 'step-change' in the quantum, continuity and duration of funding invested in bushfire research. The Hub was designed in a way that would enable it to leverage a minimum of three times that investment through cash and in-kind contributions.

In total, the Hub leveraged $16.69 million in funding. This includes planned in-kind contributions from the research partners and universities and new in-kind contributions and cash contributions. For every dollar invested by the Department, a further $3.34 was generated from in-kind and cash funding (see Figure 6.2).

Leveraged funding also included cash and in-kind contributions from other government departments and agencies (e.g. the ARC, Australian Department of Agriculture, Water and the Environment, the Victorian Department of Environment, Land, Water and Planning, and ACT Parks and Conservation), the universities, and the Bushfire and the Natural Hazards CRC. It also includes additional funding secured from the Department such as the $400,000 for the Bushfire Inquiry (provided by both the Department and the Inquiry) and $40,000 for fauna biodiversity work conducted by WP4. Most of the contributions were allocated to WP4 ($6.0 million) and WP2 ($2.5 million) related projects.

Figure 6.2 Hub funding: Department, in-kind and cash contributions



Source: ACIL Allen; the Department

Most stakeholders who commented on leveraged funding considered the Hub to be highly successful in securing additional in-kind and cash funding streams. Examples suggested by stakeholders included securing upfront investment from the partner universities, the funding sourced to perform research for the Inquiry, and several grants from the ARC and Bushfire and Natural Hazards CRC.

Future funding opportunities could consider leveraging funding from additional sources, such as the RFS and Forestry Corporation.

In contrast, some stakeholders did not believe there was sufficient transparency in how the Hub accounted for leveraged funding. It is not clear from the Hub's reporting whether the Hub's funding is being leveraged to secure additional funding to achieve Hub's core objectives or if the Hub's funding is being used to deliver on the priorities of other funding bodies. Further, some Hub status reports show that some external funding is not used for Hub-aligned research yet is being considered part of the leveraged funding total.[60] Additional transparency could help provide assurance that funding is being leveraged and appropriately used to amplify research outcomes that are aligned with the Hub's guiding principles and objectives. However, this is unlikely to occur without a detailed recording of project-level expenses and time sheets.

[60] See page 2 Progress Report 6 for WP4, which suggests that a small proportion of activities may be focused on other research priorities.

Key Finding 20 Financial impacts of the Hub

The Hub's initial $5 million investment leveraged $16.69 million in in-kind and cash contributions.

The contributions were sourced from various state and federal government departments and agencies, universities and industry.

The Hub's reporting does not specify whether the leveraged funding is delivering on the Hub's core objectives. More transparency would provide assurance that Hub resources are being appropriately leveraged.

There may be an opportunity to seek in-kind and leveraged funds to support additional communication, knowledge management and integration activities that will amplify the Hub's impact over time.

Source: ACIL Allen

6.4 Lasting legacy and future potential impacts of the Hub

The Hub's legacy includes continued delivery of Hub outputs and services and continued activities by Hub partners and end users.

Many stakeholders considered that the benefits of the Hub's research were still unfolding. Further, the benefits of this research may not be observed until future major bushfire events take place. It may be too soon to observe the Hub's outcomes and impacts (discussed in section 6.2) and, therefore, its lasting legacy.

6.4.1 Continuation of outputs and services

E.1 To what extent are the produced outputs/services likely to continue after the program timeline?

The Hub's funding will conclude in June 2022, with deliverables produced up to December 2022. Any funding that is not spent before the end of June 2022 will be returned to the Department. The Department will sign off on the final reports of each WP in December 2022.

Following the end of the Hub's funding, the Department will be responsible for the ongoing management of the Hub website and any databases that the respective university will not manage. For example, WP4's Flora and Fauna Fire Response database has been transferred to the Department for ongoing management.

Some end users were uncertain about how the research will progress following the end of the Hub's funding and would have benefited from clearer communications about the Hub's end of life planning and processes.

While the Hub may not have adequately prepared or resourced for research translation (as discussed in section 5.4) nor adequately resourced the Knowledge Exchange Officer role (as discussed in section 3.2), some stakeholders considered that there was now a significant opportunity to translate the research outputs into outputs appropriate for a broad range of end users and disseminated throughout key organisations (i.e. policy makers, operational staff). For example, NPWS and RFS would benefit from research and additional resources that supports strategy and policy, good practice guidance for new fire management practitioners, recommendations and considerations for operational staff, and community-focused communications to inform the public on the role of hazard reduction burns. While acknowledging the challenges the Department faced with a limited budget and in raising additional resources for translation, it is worth highlighting the opportunities that additional resourcing could bring.

As noted in section 5.3, several Hub researchers have or are planning to move on to new jobs. While some work is either being completed early or transitioned to new staff to complete, staff departures may impact the Hub's ability to continue to deliver services and activities following the end of the Hub's funding.

The Hub's lasting legacy and future potential impacts depend to some extent on the ongoing translation and adoption of existing and new outputs as they are developed.

Table 6.1 summarises the Hub's legacy and future potential impacts by WP and for the Hub more broadly.

Table 6.1 Continued outputs/services by WP

Work Package	Continued outputs/services
WP1	The outputs developed in WP1 (i.e. FireTools, Fire History and Smoke Tool, fuel moisture and climate trend modelling) are expected to have outcomes beyond the life of the Hub, particularly in assisting policy requirements, risk mitigation, and evaluation of risk mitigation strategies into the future. The management of FireTools will be transitioned to the Department following the end of the Hub's funding.
WP2	WP2 is developing a biophysical modelling framework and methods for quantifying the impacts of fire on carbon stores and stocks. This will assist with the quantitative prediction of fuel properties and the impact of fire regimes on carbon sequestration. These outcomes will continue beyond the life of the Hub for fire managers, climate researchers, and policy makers.
WP3	WP3 generated foundational data, new knowledge and insights that are valuable in understanding smoke modelling and the impact of smoke on human health. End users are confident that WP3 will allow for an estimate to be generated on the cost of smoke to the community. The research will also deliver other operational benefits, including plume dynamics and behaviour observations, which will likely contribute to planned burning guidelines. This research is yet to finalised.
WP4	WP4's Flora and Fauna Fire Response database has delivered a new data set on flora and fauna responses to the fire. Collecting and integrating data into the data base is likely to be an ongoing process requiring ongoing database management. The Department is managing the database beyond the life of the Hub.
WP5	Online resources developed by the WP (including the Cultural Burning for Resilience mini-documentary) will continue to be available for public access. This has the potential to continue building the knowledge and resilience of Indigenous young people. Hub-aligned research will continue with other research partners. For example, WP5 is exploring opportunities to engage in co-designed land management research with Traditional Custodians and Firesticks practitioners.
WP6	WP6 will deliver a framework for conducting risk assessments for planned burning activities. This can deliver significant value into the future as an integrated approach for fire managers (i.e. in NPWS, RFS and the Department) to assess risk.
Hub	Hub participants strongly supported the Hub's important, sizeable, and timely contribution to the Inquiry commissioned by the NSW Government in 2020. They should be considered as a key output of the Hub and recognised in its legacy. At the time, a coordinated decision was made within the Hub to place projects on hold and divert resources toward the Inquiry. The Hub's contribution was broadly seen to deliver an integrated and cohesive body of work that could not have been delivered without the Hub. This demonstrated the value of having independent expert research capacity that can be readily mobilised to address real-time policy issues.

Source: ACIL Allen, various

Key Finding 21 Lasting legacy and future potential impacts of the Hub

The Hub's funding will end in June 2022, and activities will end in December 2022.

The Department will largely be responsible for the ongoing management of the Hub website and databases.

The Hub's lasting legacy and future potential impacts can be improved by ongoing translation and adoption of existing and new outputs as they are developed.

Source: ACIL Allen

E.2 Is there evidence that program partners / beneficiaries will continue their activities beyond program support?

6.4.2 Ongoing program partner and end user activities

As discussed in section 5.3, the Hub has strengthened connections between key fire research and fire management players and has broadly enhanced the capacity of fire research in Australia. Stakeholders anticipated that these connections would continue and lead to future collaborations.

There is evidence that some Hub partners and beneficiaries will continue their activities beyond the program support. This relates to continued collaborations established or strengthened through the Hub (as discussed in section 5.3), maintenance of Hub outputs (e.g. the Flora and Fauna Fire Response database, as mentioned in section 6.4.1), and the use of Hub outputs (e.g. FireTools, as discussed in section 6.1).

Beyond these activities, research activities will continue to the extent that they are funded, for example, through the range of funding bodies that have contributed to the Hub to date (see section 6.3). These research activities will likely continue to build general knowledge around bushfires and bushfire research capacity; however, if the Department does not fund this, it increases the possibility that the research is not aligned with the Department's future policy and operational needs.

Key Finding 22 Ongoing program partner and beneficiary activities

Some Hub partners and beneficiaries will continue their activities beyond the program support.

Research activities will continue to the extent that they are funded, with the funding source guiding the research's focus and outcomes.

Source: ACIL Allen

7 Conclusions

This chapter considers how the Hub met its guiding principles (see Box 1.1*) and how the program could have been more effective in achieving its results (KEQ B.3). Key lessons learnt and recommendations for future programs are identified as well.*

7.1 Lessons and recommendations

This section outlines the conclusions identified in this report and the associated recommendations. The recommendations focus on four key areas:

- enhancing knowledge transfer and translation to amplify the Hub's impact
- using the monitoring and evaluation architecture to enhance and drive outcomes
- more explicitly finishing projects
- more explicitly planning for and managing key Hub risks.

7.1.1 Enhancing knowledge transfer and translation to amplify the Hub's impact

Enhance bushfire research that informs the Department's strategic knowledge needs and helps to improve fire management

Work closely with the Department to deliver a cost-effective research program which leverages greater investment for fire research

Ensure research information is relevant, based on the best available evidence and readily available in forms that end users can access, easily understand and use

The central tenet underpinning the raison d'etre of the Hub (and presumably any successor arrangement) is to deliver bushfire research that informs strategic knowledge needs and improves fire management practices. The focus is strongly on applied research that directly drives in-field application.

On balance, the Hub has performed well. It delivered a cost-effective research program, generating $16.69 million in leveraged funding (a $3.34 return on every $1 invested). The Hub's activities have delivered a wide range of outputs and outcomes for the NSW Government and other end users (see chapters 5 and 6 for a more detailed analysis of WP performance). Most of these outputs have focused on knowledge generation and tool development, which have in turn delivered intangible benefits, such as collaboration, engagement, and ready access to expert advice, to Hub's funders and end users.

While the Hub has delivered independent research capacity and expertise that are tailored to the NSW context (as identified by the Williams Review), the adoption and application of this research have so far been constrained. This is partly because the research outcomes are challenging to measure and attribute, and partially because they will take time to emerge.

The Hub and end users have also missed opportunities to apply the Hub's research and broaden the impact of the work. Knowledge has been slower than expected to inform policies and operational tools, the core focus of the Hub's work.

The WPs (and Hub) benefited from the work of several PhD students. While each made a significant contribution to understanding the underpinning science, it is essential to focus on the application of the science in a meaningful way. The Hub model steps away from the 'normal' academic researcher model, whereby publications and citations measure success and value.

These standard measures are of limited relevance and do not inform the success and performance of a Hub focused on applied research.

Foster transfer and integration of skills and knowledge to the Department and also between research institutions, government agencies, Aboriginal co-management partners and the communities that the Department serves.

For the Hub to be successful, all participants (the Department, universities and researchers) need to acknowledge that the research effort (and researcher rewards) needs to be judged differently – that is 'has the research led to day-to-day application?'. KPIs need to be developed accordingly, and the incentives used by the researchers' home institutions need to acknowledge the value that applied (operationally focused) research can deliver. Non-academic or publishing performance has been recognised and rewarded by the host institutions of other research hubs and centres that ACIL Allen has evaluated in the past.

It is essential to integrate the end users into the process of knowledge transfer and translation every step of the way (e.g. from the determination of research priorities, design and execution of the actual research, and the formulation of a comprehensive plan and approach to see its wide deployment). This means adequately resourcing and authorising end users to participate fully and commit their organisations to the research process. They need to take ownership of both the research and using it.

Recommendation 1

Adequately resource and integrate end users in every step of the research translation process to ensure:

- end users receive research outputs that are targeted to their needs and support them to manage bushfires and environmental priorities
- knowledge and research are applied
- the research delivers outcomes and impacts.

It is best practice for research models to fund a dedicated knowledge management function. This function facilitates relationships among participants and end users to support information flows, reduce duplication and overlap, and support end user engagement and research adoption. However, this role is not typically embedded into the design and implementation of research models like the Hub.

The Knowledge Exchange Officer performed both an administrative function to account for progress and facilitate discussion on the performance of the WPs, and a knowledge management/brokering function to connect researchers and support collaboration with end users. The role was highly valued by stakeholders consulted but seen by many to have been under-resourced.

To amplify a future Hub's impact, the knowledge management function would benefit from additional staffing resources (especially FTEs). A small team (rather than an individual) would provide the focus and end user support required to ensure participation at every step of the research process. A team of knowledge brokers (if well managed) could ensure that end user needs inform more of the researchers' decisions, and more researcher decisions/insights inform end user actions. This would also allow for more effective WP delivery.

Recommendation 2

Better resource and task the knowledge management function to amplify Hub outcomes.

7.1.2 Using the monitoring and evaluation architecture to enhance and drive outcomes

The program logic is the core design architecture of any program. It identifies the overarching objectives and the outcomes the intervention intends to achieve and shapes its operational, performance and accountability arrangements.

It is best practice for the program logic to be developed during the program design phase, closely link to the key activities to be delivered and clearly identify the pathway to impact. This facilitates effective progress reporting and transparency around performance issues and accountabilities.

The Hub's program logic, though not required under the Department's monitoring and evaluation requirements, was useful in articulating the Hub's direction. However, it did not drive the Hub's operations, management, governance, monitoring and evaluation activities.

Recommendation 3

Integrate the program logic into the early design and ongoing management of the program so that the outcomes and objectives of the Hub drive activities, reporting, performance management and evaluation.

To demonstrate impact and attribution of the Hub's performance, best practice dictates that Specific, Measurable, Achievable, Realistic, and Timely (SMART) KPIs need to be developed. These KPIs should focus on the outcomes and impacts that directly relate to the Hub's outcomes and objectives (as identified in the program logic). The development of SMARTer KPIs for any future funding would facilitate better comparison within and across outcome classes and a collective assessment of performance over time.

There are opportunities to improve the way the KPIs are constructed to better align with best practice principles. This should be done in collaboration with the Hub Steering Committee to ensure the KPIs allow for reporting that meets the committee's needs. However, given the advanced stage of the Hub's implementation, the opportunity to develop/refine the KPIs has passed. It will be essential to test any future KPIs using the SMART criteria (as a filter) before adopting them as part of any future performance and accountability architecture. Using these criteria will likely lead to fewer but more meaningful KPIs, which will simplify and enhance the performance story of any future efforts.

To make use of SMART KPIs, best practice reporting is needed to drive the monitoring of and accountability for risks and performance. Best practice dictates that reporting should be proportionate to the amount of funding being provided, be streamlined/consolidated to reduce the administrative burden on those reporting, and help inform decision making.

Any future reporting could better meet these best practice principles, by requiring reporting on all KPIs, and using the reporting to drive meaningful action on accountability and performance.

Recommendation 4

Develop and routinely report on SMART KPIs to drive accountability, data collection, reporting, performance management and evaluation. Reporting should clearly link to the Hub outcomes.

7.1.3 More explicitly finishing projects

WP progress reporting did not effectively capture progress toward and achievement of milestones and outcomes, and there were no formal processes for finalising WP activities. In most instances, the researchers developed outputs that were accepted as finalised by third parties (i.e. academic papers, newspaper articles).

Given the guiding principles of the Hub include delivering applied research and fostering the transfer and integration of skills and knowledge, the Department and other key end users must be more closely involved in reviewing and approving the final outputs of the Hub. This would support end users to better guide the Hub and facilitate discussions on whether the research has met the needs of end users (i.e. Is it what was asked for? Has it been adopted? Is it useful?) and whether unused resources can be reallocated to other Hub activities.

Recommendation 5

Develop formal project and WP completion processes that integrate end users to facilitate discussions on research adoption and reallocation of resources.

7.1.4 More explicitly planning for and managing key Hub risks

The efficiency and effectiveness of the Hub's governance and implementation

The Hub Steering Committee began formal discussions on risk management relatively late in the Hub's life. Key risks were not adequately planned for or managed. These risks include the premature departure of key Hub staff which has created continuity issues and delayed and compromised the delivery of some outputs.

While contract and funding uncertainty is inherent in research models and is likely unavoidable, these risks could have been better planned and mitigated. Better risk planning could have prompted early-stage WP design and delivery decisions to minimise these risks.

Recommendation 6

Incorporate active risk planning and management into the governance arrangements at strategic and operational levels to better identify and mitigate risks.

Strengthen planning for the end of the Hub to support researcher engagement and completion of research projects.

7.2 Final thoughts

The Hub was established to meet a clear need for independent fit-for-purpose research, and for approximately $5 million, it has delivered on that need. Many stakeholders consulted for this evaluation highly value the work of the Hub, and believe it represents good value for money to the NSW Government. ACIL Allen supports many of the sentiments of value expressed during this evaluation. There is a strong business case for a hub, or something similar, to continue.

That said, there are opportunities to strengthen the Hub. There are some lessons from the Hub's implementation that should be noted. In particular, future hubs need to better plan for and mitigate researcher departures, especially when researcher roles are single point critical.

A future hub also needs to invest a significant proportion of its resources in knowledge translation, transfer and exchange. Depending on the nature of the specific project, this could be as high as the amount invested in the generation of knowledge. This will ensure that the value of the Hub's research is being captured and used by people in a wide range of policy, strategic and operational roles.

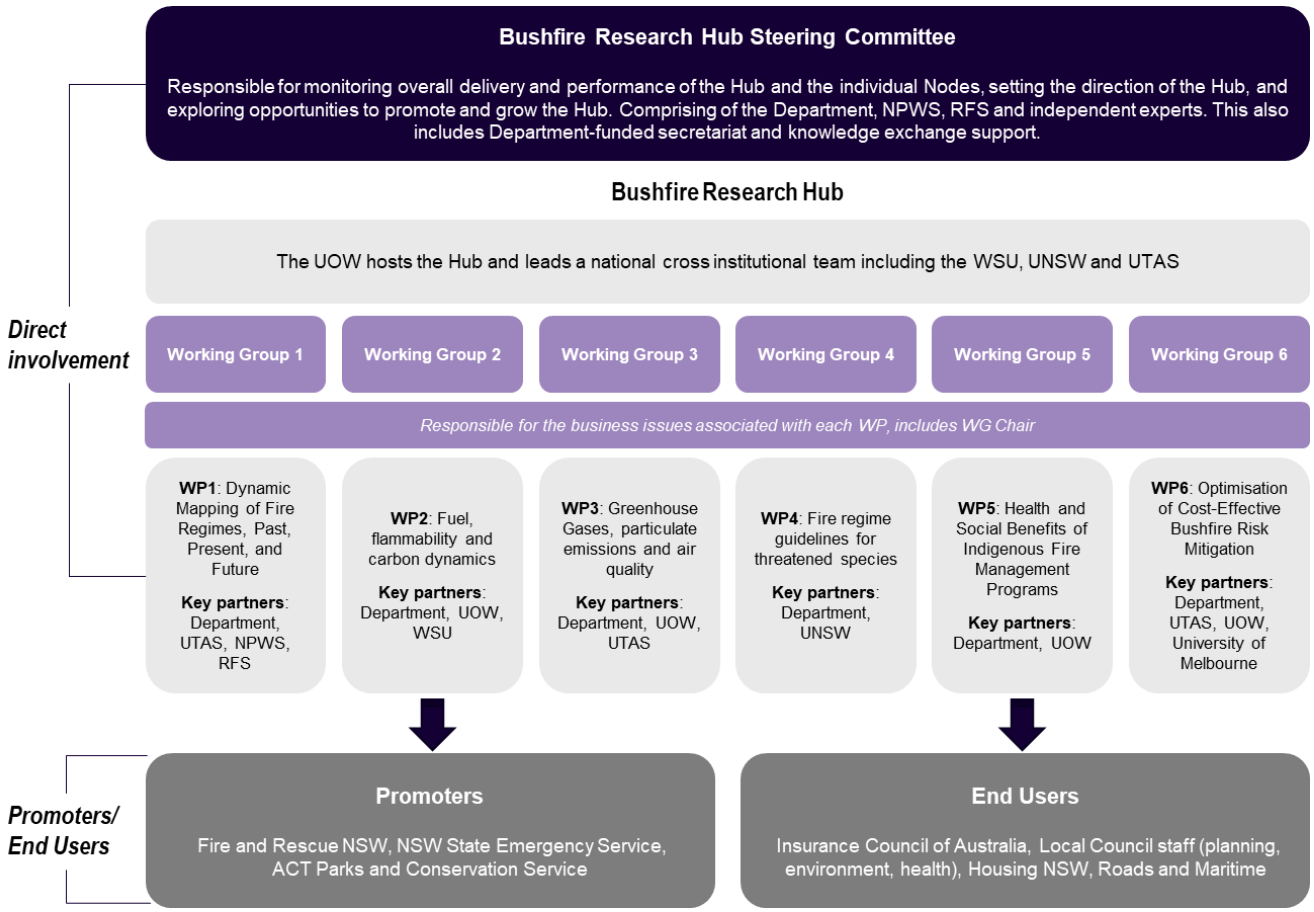
Finally, a future Hub needs sound performance and accountability architecture. There is scope to improve this architecture next time.

Supporting information A

A.1 Key Hub stakeholders

A number of key stakeholders are involved in the operation of the Hub, including Working Groups and Working Group Chairperson, researchers, the Knowledge Exchange Officer, promoters and end users. The roles and responsibilities of each stakeholder are overviewed in Figure A.1 and detailed below.

Figure A.1 Hub governance arrangements and links to stakeholders



Source: ACIL Allen; Bushfire Research Hub Governance Arrangements (unfinalised); Bushfire Risk Management Research Hub – Working Groups Terms of Reference; WP Progress Reports

Hub Steering Committee

The Bushfire Risk Management Research Hub Steering Committee (Hub Steering Committee) provided advice on the establishment of the Hub and has ongoing responsibility for monitoring the overall delivery and performance of the Hub and the individual projects, setting and maintaining the direction of the Hub, and exploring opportunities to promote and grow the Hub.

The overall objectives of the Steering Committee are to:

- develop and, where appropriate, evaluate fire ecology and management research projects
- assist the Department to develop and maintain appropriate research partnerships to implement the five-year research program
- guide and develop research and knowledge transfer investment strategies over the life of the Hub, so that the research provides a framework for the Department and partners to evaluate management effectiveness.

In meeting its objectives, the role of the Steering Committee is to:

- assess progress of each WP and ensuring project deliverables are aligned with aims and objectives of each WP
- ensure effort and expenditure are appropriate to stakeholder expectations
- address any issues that may have major implications for the Hub and the WPs
- review WP budgets, expenditure and future years funding allocations

— reconcile differences in opinion and approach, and resolve disputes arising from them.

Hub Chair

The Hub Chair is responsible for

Working Groups

There are six working groups including one working group for each Hub WP.[61] The Working Groups are responsible for the business issues associated with each WP including approving individual project proposals and budget allocations, monitoring achievement of milestones and deliverables, and monitoring risks, quality and timeliness.

Each Working Group comprises of at least four members with representation from the Department, UOW and its partner Universities and lead end user agencies: NPWS, Rural Fire Services, Department representatives from divisions related to regional operations, policy and science.[62]

Individual projects delivered under the respective WP submit a Project Proposal to the respective Working Group for approval before proceeding. Following approval, the project is then required to submit Progress Reports on a biannual basis, and a Final Report upon completion to the respective Working Group. The WP leader is required to submit a Program-wide Progress Report to the Hub Steering Committee annually.

Working Group Chairperson

The Chair of each Working Group (chosen by the Working Group from the lead end user agencies) is to provide efficiencies and consistency across the administration of the WP including organising any meetings. The chair is responsible for:

— liaising with the Steering Committee and ensuring the Working Group maintains focus on tasks assigned by the Steering Committee

— clarifying the purpose of each meeting, setting the agenda for each meeting, ensuring agendas and supporting materials are delivered to members before meetings

— clarifying and summarising discussion during each meeting, and encouraging participation by members

— summarising decisions and assignments at the end of each meeting

— checking with consistently absent members to determine their ability to continue membership, and finding replacements for members who discontinue participation.

WP researchers

WP researchers are responsible for designing and conducting the research activities associated with each WP. They work with end-users through the Working Group and report their progress to Working Groups and Hub Steering Committee.

Secretariat and knowledge exchange support

The Department funded and resourced secretariat and additional knowledge exchange support to the Hub Steering Committee and Working Group meetings (i.e. a Knowledge Broker) and this role was performed by a project officer from the then Ecosystem Management Science Branch. Responsibilities of this role were intended to include project management and related

[61] Unknown author (2018). *Bushfire Risk Management Research Hub – Working Groups Terms of Reference*.

[62] Bushfire Research Hub (2017). *Governance arrangements - Document Version 1.0*. Sydney: NSW Government.

administrative duties and knowledge management activities as directed by the Chair of the Hub Steering Committee.[63]

Promoters

Promoters are organisations who may want to promote the communications from the Hub within their own organisation. Promoters may include State Government, Local Government, research organisations, interstate agencies, commonwealth and international agencies, as well as industry or community members.

End users

End users are individuals or groups within organisations that may find the communications from the Hub relevant to them personally. End users may include State Government, Local Government, research organisations, interstate agencies, Commonwealth and international agencies, as well as industry or community members.

A.2 Overview of the WPs

A.2.1 WP 1 Dynamic Mapping of Fire Regimes, Past, Present, and Future

WP1 is developing FireTools, a dynamic fire regime geographic information system (GIS) database and embedded software platform. FireTools aims to inform planning for prescribed burns and to understand the potential changes in fire risks over time.

WP1 uses historical fire and vegetation data, along with mapping tools and expert analysis, to understand patterns of intensity, severity, spread, return interval, and smoke dispersion, and how climate change affects these factors over time. FireTools aims to build an understanding of fire return intervals across NSW ecosystems, the drivers of extreme fire behaviour in the past and future, and trade-offs in emissions from planned burns and wildfires. This will support behavioural modelling of fires and climate trends, and allow retrospective evaluation of the impact and scale of specific fires.[64]

WP1 aims to transform pyrogeographic research capabilities and enable fire managers to improve risk management by providing the first sub-continental scale understanding of the biophysical drivers of individual fires and the emergence of fire regimes.[65]

The aims of WP1 are pivotal to the objectives of the Hub and other WPs.[66]

The specific objectives of WP1 are to:

- Develop a geographic information system to capture and systematise consolidation and validation of existing fire mapping currently held by NSW agencies, and provide a historical framework of past fires and emergent management patterns
- Capture and integrate geographical, biophysical and climate data to parametrise fire behaviour models and underpin pyrogeographic analysis
- Enhance the GIS data system to enable interactive modelling using a suite of embedded fire behaviour models, to predict fire behaviour, greenhouse gas (GHG) emissions, and smoke

[63] Bushfire Research Hub (2017). *Governance arrangements - Document Version 1.0*. Op. cit.

[64] NSW Bushfire Risk Management Research Hub (2021). *Dynamic mapping of fire regimes, past, present, and future*. Op. cit.

[65] Ibid.

[66] NSW Government Office of Environment and Heritage (2017). WP1 Project Plan Proposal.

plumes in response to planned burns and wildfires under current and future weather conditions

- Use embedded fire behaviour models to enable the first quantification of putative Aboriginal fire regimes using habitat suitability modelling, utilising archaeological records to identify areas of intensive land use and occupancy
- Create decision-support tools to predict consequences of different planned burn options that can be used in the development of fire management plans, with user-friendly interfaces so that managers and researchers can query the terrain, vegetation type, cadastral data, and critical infrastructure affected by each fire and generate scenarios of resultant fire regime patterns
- Advance a pyrogeographic understanding of the past, present, and future fire regimes across NSW through targeted analysis and scenario-exploration using the database and decision-support tools
- Develop and refine empirically derived equations to quantify the risk reduction in housing loss, and reduction in fire severity associated with various burning and mechanical fuel treatments across a range of fire weather conditions.[67]

WP1 aims to achieve these objectives by developing an online interactive tool that analyses historic fire and vegetation data and allows users to explore fire and climate trends, and trade-offs in emissions from planned burns and wildfires.[68]

A.2.2 WP2 – Fuel, Flammability, and Carbon Dynamics

WP2, Fuel, Flammability, and Carbon Dynamics, is developing an understanding of landscape-level variation in fuels and fire behaviour and severity, to provide fire managers with the tools to predict the types, quantities, and moisture content of fuels across NSW's landscape.[69]

The NSW landscape is varied, with fire regimes forming around diverse climates, soils, and vegetation types. There is an opportunity to enhance predictive tools relating to the behaviour and severity of fires in a way that complements terrain and weather-based information. However, the variability of these characteristics presents a challenge for predictive modelling and evaluation.

WP2 is using field observations and remote sensing to develop predictive models for landscape-scale variation in fuel types, loads, moisture content and forest flammability across NSW. This will allow for informed decision-making on fire management measures through the quantification of fire risk in relation to communities, infrastructure, and biodiversity and carbon stocks.[70] The aims of WP2 are to enhance the capacity of fire management to quantitatively predict the local status of key fuel properties across NSW and to quantify the impact of contemporary fire regimes on ecosystem-level carbon sequestration.[71]

Specifically, WP2 aims to:

- To build spatially explicit probabilistic models of the composition of broad vegetation formations in NSW in terms of the major fuel forming plant functional types
- To develop mechanistic models for the prediction of fuel accumulation dynamics under major fuel forming plant functional types

[67] Ibid.

[68] NSW Bushfire Risk Management Research Hub (2021). *Dynamic mapping of fire regimes, past, present, and future*. Op. cit.

[69] NSW Bushfire Risk Management Research Hub (2021). *Fuel, Flammability, and Carbon Dynamics*. Op. cit.

[70] Ibid.

[71] NSW Government Office of Environment and Heritage (2017). *WP2 Project Plan Proposal*.

— To develop models and workflows for the spatially explicit monitoring and forecasting of landscape flammability as a function of fuel moisture content

— To quantify the effects of current fire regimes on Gross Primary Productivity and carbon stocks in forests and woodlands using satellite remote sensing and flux measurements.[72]

The methodology employed in this project includes collecting field observations and remotely sensed data on vegetation and fuels to develop models for the landscape-scale variation in fuel type and load, developing tools for monitoring and forecasting fuel moisture content and associated variation in forest flammability, and using satellite data to quantify the effects of fire regimes on carbon captured and stored in forests. Fuel composition modelling will be developed based on literature review and consultation to identify the plant functional types that determine key fuel characteristics, as well as georeferenced data observations, and satellite-based data products. Fuel accumulation dynamic models will be developed through adaptation of existing models, as well as estimation of local values from spatial information. Similarly, carbon uptake and stock behaviours and effects on Gross Primary Productivity will be quantified based on existing models.

A.2.3 WP3 – Greenhouse Gasses, Particulate Emissions, and Air Quality

WP3, Greenhouse Gasses, Particulate Emissions, and Air Quality is exploring the impacts of bushfire smoke on the environment and human health.[73]

While prescribed burning can be successful at reducing the severity and area of fires, such burning produces smoke, which affects both human health and the environment. WP3 is exploring the extent to which planned burning changes the total amount of GHG emissions produced by fires, changes overall air quality, and impacts on public health.[74] It is developing modelling that incorporates fire intensity, fuel moisture content, proximity to population centres, and weather and atmospheric conditions to estimate the impact of smoke from individual fires. This information will be used to define the planned burning strategies that are most likely to reduce overall exposure to smoke, GHG emissions and exposure of people to air quality levels that are deleterious to human health.[75]

WP3 involves:

— Measuring fuel consumption and estimating GHG and particulate emissions from a range of prescribed burns and bushfires

— Analysing the drivers of air-quality impact from past fires to improve understanding, prediction, and mitigation

— Evaluating air quality prediction models as used by fire management agencies

— Modelling the emissions from a range of prescribed burning rates and arrangements to identify strategies that minimise emissions and pollutant exposure.[76]

The first element of WP3's approach is its empirical and experimental characterisation of emissions. This involves the collection and analysis of existing and new data. Field campaigns to quantify emissions from planned burns across myriad fuel types, moisture contents, and fire intensities in conjunction with laboratory study that simulates wildfire conditions will be used to

[72] Ibid.

[73] NSW Bushfire Risk Management Research Hub (2021). *Greenhouse Gasses, Particulate Emissions, and Air Quality*. Accessed 1 Mar 2022: https://www.bushfirehub.org/work-packages/emissions-from-prescribed-burning/.

[74] Ibid.

[75] NSW Government Office of Environment and Heritage (2017). *WP3 Project Plan Proposal*.

[76] NSW Bushfire Risk Management Research Hub (2021). *Greenhouse Gasses, Particulate Emissions, and Air Quality*. Op. cit.

establish specific profiles for GHG emissions and particulates. The second element of the approach is to develop predictive modelling to estimate the relationship between different planned burning strategies and GHG emissions and particulates. An accounting framework is used to record the net balance of emissions following a prescribed burn. This allows for comparative analysis of differing planned burning strategies.

A.2.4 WP4 - Fire Regime Guidelines for Conservation of Threatened Species

WP4, Fire Regime Guidelines for Conservation of Threatened Species, focuses on protecting plant and animal species biodiversity from threats related to fire regimes and changes in fire regimes.[77] WP4 is exploring fire management knowledge gaps related to biodiversity, planned burning, cultural burning, and human and environmental health. These gaps are critical to NSW's environmental well-being and fire management. WP4 is also developing Thresholds of Potential Concern for fire regime characteristics such as frequency, season, severity, and spatial configuration, which are currently poorly defined.[78] Measurement and analysis of these fire regime characteristics will inform how threatened species can persist under changing fire regimes and climate change.[79]

The specific aims of WP4 are to:

- Develop a new database of review, compile data on plant species fire response traits, and develop an advanced database structure for storage and retrieval
- Characterise the sensitivities of species to key components of fire regime by defining functional groups, using a set of traits including fire response, dormancy, and seed longevity
- Develop modelling capacity for threatened biota to explore the consequences of alternative fire management scenarios
- Estimate the Thresholds of Potential Concern in fire regimes to inform fire management for conservation of threatened plant species from each defined functional group.[80]

The methodology of WP4 is comprised of two parts. The first part is empirical and involves reviewing the plant species traits that are likely critical to the persistence of population in response to fire frequency. These traits are then recorded in a database that provides additional contextual information. Then, researchers identify the representative functional groups from the species traits database, which is important for assessing the sensitivities of species to different fire regimes. The second part of the approach develops a stochastic population model parameterised by the data collected in the process of building the database, in order to evaluate sensitivities to various fire regimes; seasonality and severity in particular. These models are then used to undertake population viability analyses that can be used to estimate Thresholds of Potential Concern for various components of fire regimes. Analysis of biotic responses at specific sites will be used to validate the estimates for thresholds produced by the model.[81]

A.2.5 WP5 – Health and Social Benefits of Indigenous Fire Management Programs

WP5, Health and Social Benefits of Indigenous Fire Management Programs, focuses on developing our understanding of how cultural engagement is linked to well-being and resilience, particularly in

[77] NSW Bushfire Risk Management Research Hub (2021). *Fire Regime Guidelines for Conservation of Threatened Species*. Accessed 1 Mar 2022: https://www.bushfirehub.org/work-packages/fire-seasons-severity-and-biodiversity/.

[78] NSW Government Office of Environment and Heritage (2017). *WP4 Project Plan Proposal*.

[79] NSW Bushfire Risk Management Research Hub (2021). *Fire Regime Guidelines for Conservation of Threatened Species*. Op. cit.

[80] NSW Government Office of Environment and Heritage (2017). *WP4 Project Plan Proposal*.

[81] Ibid.

relation to fire and land knowledge and management.[82] A critical challenge for exploring the intersection of ecological, economic, cultural, and health benefits of Indigenous fire management practices is to develop a comprehensive case for the expansion and coordination of these activities, particularly as these activities potentially provide benefits for biodiversity and the health and well-being of Indigenous people involved.[83]

WP5 seeks to explore cultural burning initiatives in NSW, understand lived experiences and motivations of Indigenous people engaged in cultural burning, document opportunities and barriers to expanding these practices, investigate how renewed engagement in cultural burning leads to cultural renewal and its link with well-being and resilience, and explore the development of participatory indicators to foster and monitor cultural renewal and well-being.[84]

WP5 aims to address the following questions:

— What types of cultural burning initiatives exist now and are likely to be undertaken in the future? Where are they, and who is involved? What are their objectives and activities?
— What are the barriers, incentives, and opportunities for expanding Indigenous fire management approaches and enhancing their overall contribution to bushfire risk management?
— What are the personal experiences of Aboriginal people engaged in cultural burning? How might these determine emergent social and health benefits, not only for those people but also the wider community?
— How compatible are existing planned burning programs with contemporary cultural burning approaches? How can this contribution be enhanced and sustained through the establishment of a MER framework for cultural burning that integrates potential health benefits in a transdisciplinary framework?[85]

The WP5 methodology is focused on several themes, and cumulatively seeks to explore cultural burning initiatives in NSW, understand lived experiences and motivations of Aboriginal people engaged in cultural burning, document opportunities and barriers to expanding these practices, investigate how renewed engagement in cultural burning leads to cultural renewal and its link with well-being and resilience, and explore the development of participatory indicators to foster and monitor cultural renewal and well-being.[86] The approach is divided into three parts.

The first part involves understanding the range of cultural burning activities by using a networking approach to identify and develop links between people and groups to map the people involved and the range of activities. Interviews will then be used to understand the scope of past, present, and future fire management carried out by existing agencies. The second part involves collaborative documentation of the transformative potential of cultural burning, particularly with respect to lived experiences and the meaning and purpose of these activities. The information gathered will be analysed and published in an academic format, as well as in a format suitable for a wider audience. The third part concerns opportunities and barriers relating to the interaction of these cultural burning practices and agencies, and their expansion. This involves developing a framework for planning, monitoring, evaluating, and improving cultural burning and fire management activities,

[82] NSW Bushfire Risk Management Research Hub (2021). *Indigenous Cultural Burning: Exploring the Links Between Cultural Revitalisation and Wellbeing*. Op. cit.

[83] NSW Government Office of Environment and Heritage (2017). *WP5 Project Plan Proposal*.

[84] Ibid.

[85] Ibid.

[86] Ibid.

while fostering leadership, mentoring, and general technical capacities. These tasks will serve as a baseline for measuring future performance.[87]

A.2.6 WP6 – Optimisation of Cost-Effective Bushfire Risk Mitigation

WP6, Optimisation of Cost-Effective Bushfire Risk Mitigation, focuses on the impact of prescribed burning on fire regimes, property, infrastructure, biodiversity, health, and the environment.[88] WP6 will integrate results relating to the identification of effective planned burning strategies from all other WPs to identify optimal solutions for cost-effective planned burning that builds on existing knowledge. These solutions will also provide adaptation to future human and climatic changes.[89]

The aims of WP6 are as follows

- Estimation of the relative alignment of prescribed burning strategies that are likely to lead the best outcome, in terms of risk mitigation, for each key value.
- If such ideal strategies are not aligned, estimate whether an acceptable compromise can be defined, that produces a reasonable trade-off in risk mitigation across these values.
- Estimation of the degree that such a trade-off solution is applicable across all environments in NSW, or whether adjustment is required to suit differing environmental and human context.
- Estimation of whether such solution will be robust to future climatic and human changes.
- Estimation of the cost-effectiveness of such potential trade-off strategies, in terms of planning, operational and implementation costs, collateral costs, and both direct and indirect savings derived from mitigation of various risks, abatement of GHGs and improvements in well-being.
- Application of these results to evaluate the likely cost-effectiveness of the Enhanced Bushfire Management Program and other bushfire risk management policy and panning initiatives.
- Application of these results via the use of use of decision-support and planning tools to adjust prescribed burning strategies through the identification of when, where, and how planned burning can be pinpointed to best effect in landscapes in the future.[90]

The methodology has three stages. The first stage addresses the first four aims through integrated modelling of fire regime and risk. Estimating risk mitigation and analysing mitigation trade-offs are explored by modelling fire spread in planned burning scenarios in a range of ecosystems and climate conditions. The estimated risk sensitivities are then used as inputs in existing decision analysis models, which will yield trade-off options as a function of differing fire regimes. Outputs in this process will be integrated with results from WP3, WP4, and WP5 to incorporate findings relating to GHG emissions and particulates, biodiversity, and potential health benefits, respectively.[91]

The second stage addresses fifth aim of WP6, which is to estimate the cost effectiveness of trade-off solutions developed in the first stage. Key inputs in this process include operational data such as the costs of planned burning, as well as human and environmental assets and other relevant information.[92]

[87] Ibid.

[88] NSW Bushfire Risk Management Research Hub (2021). *Optimising Cost-Effective Bushfire Risk Mitigation Via Panned Burning*. Accessed 1 Mar 2022: https://www.bushfirehub.org/work-packages/understanding-indigenous-fire-management/.

[89] NSW Government Office of Environment and Heritage (2017). *WP6 Project Plan Proposal*.

[90] Ibid.

[91] Ibid.

[92] Ibid.

The third stage addresses the sixth and seventh aims of WP6, which are to evaluate the cost effectiveness of the Enhanced Bushfire Management Program (and other bushfire risk management initiatives), and to apply these results to adjust prescribed burning strategies, respectively. Consequently, estimates of risk, trade-offs, and the cost-effectiveness of specific strategies has implications for fire policy and planning.[93]

A.3 Evaluation framework

The evaluation framework builds on the Hub evaluation plan and leverages insights from the CCF Evaluation Framework and other supporting documents, including the NSW Benefits Realisation Management Framework, Treasury Guidelines: NSW Government Guide to Cost-Benefit Analysis. The evaluation framing (combining the KEQs, KPIs and data sources and analysis methods) is provided in Table A.1. It has been updated based on information obtained from the inception meeting, background review and through the initial insights gathering.

[93] Ibid.

Table A.1 Evaluation framing

KEQs	KPIs	Data sources / analysis		
		Program data	Stakeholder interviews	Financial analysis
Appropriateness				
QA.1 To what extent is the program relevant to NSW needs and priorities?	– KPI 5: Hub projects align with, inform and meet: OEH/*DPIE* Knowledge Strategies, CCF Objectives or Enhanced Bushfire Management Program Objectives	✓	✓	
QA.2 To what extent was there effective co-design and co-delivery with end users?	– KPI 11: OEH/*DPIE*/NPWS staff assigned and involved in each work package from start to finish, PhDs established, host researchers and OEH/*DPIE*/NPWS staff co-located	✓	✓	
QA.3 How appropriate were the knowledge delivery mechanisms?	– KPI 6: Identified target groups of Hub agree they have access to and can understand and use information – KPI 7: Strategies are defined, summarised and disseminated to target groups – KPI 8: Influences are summarised and disseminated to 100% of target groups – KPI 9: Identified changes are listed, summarised and disseminated to target groups – *KPI 12: Knowledge exchange funded and Hub Steering Committee (SC) approve and endorse: project plan, OEH/DPIE communication and engagement strategy, Host Communication Plan* – KPI 13: Online fire regime interfaces & tools launched. Fire regime automation and decision support systems implemented – KPI 14: State-wide models of fuel, moisture and carbon dynamics developed. Fuel, moisture and carbon forecasting capacity implemented and integrated – KPI 15: Regimes are quantified, summarised and disseminated to target groups – KPI 16: Management's ability is quantified, summarised and disseminated to target groups – *KPI 18: Data Management Plan approved by Hub SC. Data stored, version controlled with metadata*	✓	✓	
Effectiveness				
QB.1 To what extent were program outputs accessed and used by target end users?	– KPI 6 – *KPI 2: New strategies for planned burning for the future delivered to direct stakeholders and implemented* – *KPI 20: Hub SC-endorsed OEH/DPIE communication and engagement strategy is adhered to*	✓	✓	
QB.2 To what extent were program outputs produced in the right form and in a timely fashion?	– KPI 6 – *KPI 19: Direct involvement stakeholders agree they receive timely advice and recommendations from the Hub and the Project Manager* – *KPI 21: Progress and Final Reports approved by Hub SC*	✓	✓	
QB.3 How could the program be more effective in achieving its results?	– Lessons learned on Hub design and delivery	✓	✓	

KEQs	KPIs	Data sources / analysis		
		Program data	Stakeholder interviews	Financial analysis
Consider partnership models, governance arrangements, knowledge delivery strategies, modelling, mapping and analysis processes, engagement.				
Impacts				
QC.1 To what extent are policies and planning requirements informed by information, knowledge and tools produced?	– KPI 3	✓	✓	
QC.2 To what extent has the information been used by end users outside the original target group?	– KPI 6	✓	✓	
QC.3 To what extent has the program achieved positive changes in the environment	– KPI 1: Optimal, cost-effective approaches for planned burning defined – KPI 3, 7, 16	✓	✓	
Efficiency				
QD.1 To what extent has the program been able to leverage additional resources (cash and in-kind contributions)?	– KPI 4: Leveraged research from OEH/*DPIE* funds achieved and Program completed	✓	✓	✓
QD.2 To what extent were partnerships / linkages between institutions / organisations encouraged and supported? Which partnerships / linkages were established? Which partnerships / linkages can be considered sustainable?	– KPI 3: Count of policies and operations developed and updated through information from the Hub – KPI 10: Hub SC meet biannually and establish objectives	✓	✓	
Legacy				
QE.1 To what extent are the produced outputs / services likely to continue after the program timeline?	– KPI 13,14	✓	✓	
QE.2 Is there evidence that program partners / beneficiaries will continue their activities beyond program support?	– KPI 4, 11	✓	✓	
QE.3 To what degree is there local ownership of program results?	– KPI 3	✓	✓	
Equity				
QF.1 To what extent do the program targets treat vulnerable communities, sectors and regions equitably?	– KPI 7, 8	✓	✓	
QF.2 To what extent have regional issues been considered in identifying risks and opportunities, and developing tools?	– KPI 7, 8	✓	✓	
QF.3 To what extent has the program targeted high-climate-risk areas and -communities?	– KPI 9 – KPI 17: Hub SC approved research papers submitted	✓	✓	

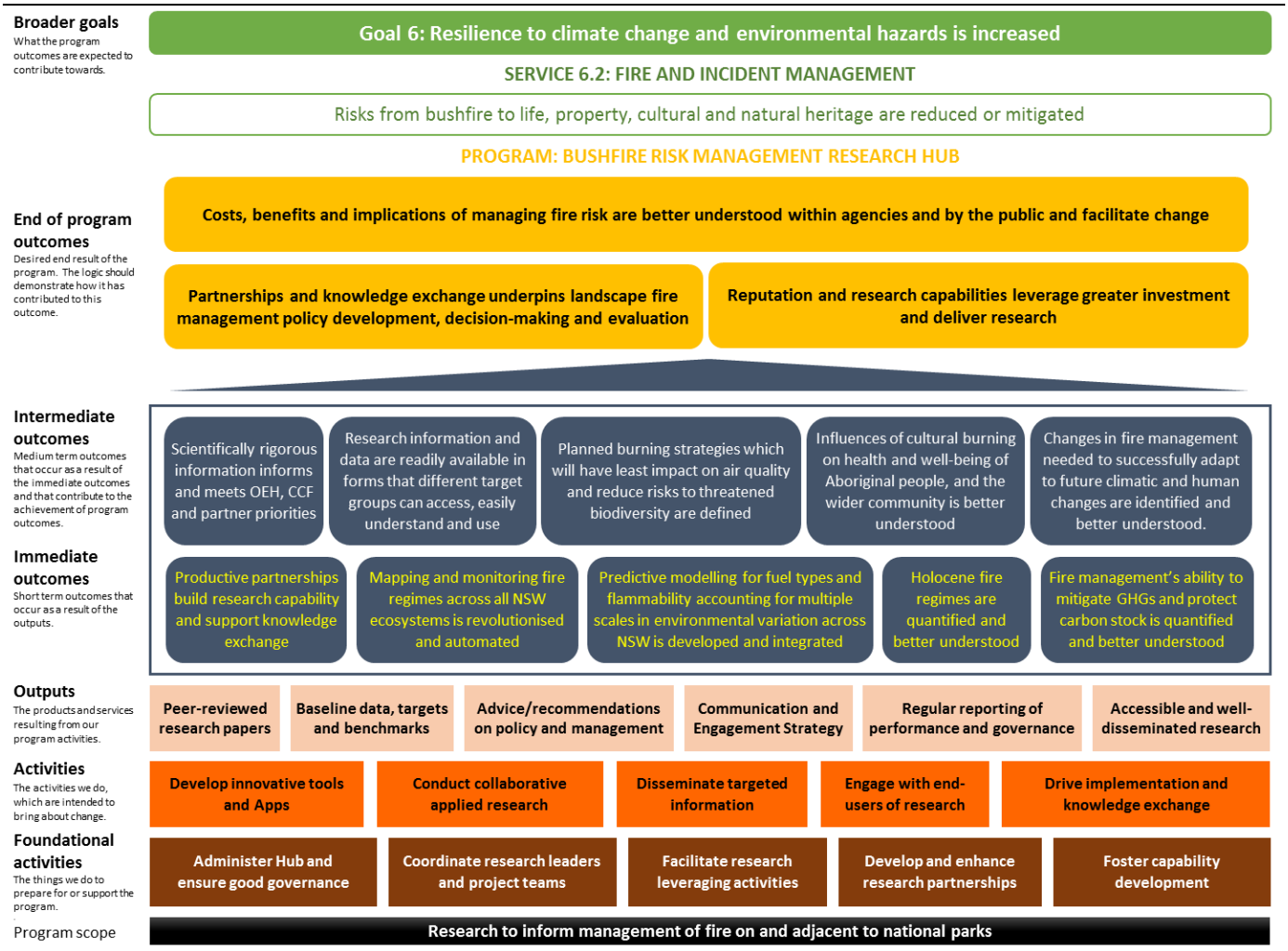
KEQs	KPIs	Data sources / analysis		
		Program data	Stakeholder interviews	Financial analysis

Source: ACIL Allen, OEH Evaluation Plan - Bushfire Risk Management Research Hub (2017)

A.4 Program logic

The program logic is provided in Figure A.1.

Figure A.1 Hub program logic



Source: OEH Evaluation Plan - Bushfire Risk Management Research Hub (2017)

A.5 NSW Government strategies and programs

The WP objectives were assessed for their alignment to the outcomes and purposes of the following NSW Government strategies and programs:

— Enhanced Bushfire Management Program

  - Costs, benefits and implications of managing fire risk are better understood within agencies and by the public and facilitate change
  - Safer and resilient communities
  - Risk management informs the fire management and mitigation program
  - Knowledge underpins fire management, policy decision-making and evaluation
  - Natural and cultural values are conserved through effective management
- Climate Change Fund – purpose
  - To provide funding to reduce greenhouse gas emissions and the impacts of climate change associated with water and energy activities
  - To provide funding to encourage water and energy savings and the recycling of water
  - To provide funding to reduce the demand for water and energy, including addressing peak demand for energy
  - To provide funding to stimulate investment in innovative water and energy savings measures
  - To provide funding to increase public awareness and acceptance of the importance of climate change and water and energy savings measures
  - To provide funding for contributions made by the State for the purposes of national energy regulation
- Biodiversity Knowledge Strategy
  - Understand the abundance and distribution of biodiversity
  - Understand ecosystem services to better manage species
  - Understand appropriate management actions and how to prioritise them
  - Understand the effectiveness of existing processes and tools to conserve biodiversity
- Climate Change Impacts and Adaptation Knowledge Strategy
  - NSW Adaptation Research Hub - Adaptive Communities, Biodiversity and Coastal Processes and Responses Nodes
- Coastal, Estuarine & Marine Environments Knowledge Strategy
  - Understand coastal values to balance multiple uses
  - Understand coastal erosion to develop management responses
  - Understand estuarine foreshore inundation and sea level rise
  - Understand and predict estuarine responses to management actions
  - Understand conservation needs for better regulation
- Water and Wetlands Knowledge Strategy
  - Understand the extent and condition of wetlands and groundwater-dependent ecosystems
  - Understand and apply the best management tools for aquatic resources
  - Understand acceptable target conditions for aquatic ecosystems
  - Understand how wetlands and floodplains function
  - Understand and measure progress
- Landscape management Knowledge Strategy
  - Understand landscape processes and ecosystem services
  - Understand social drivers of landscape change
  - Understand biophysical drivers of landscape change
  - Understand landscapes through monitoring and collecting data
  - Understand how to assess and manage landscapes by using decision-support systems
- Resource efficiency Knowledge Strategy
  - Develop understanding of how priority resources are used in NSW

  - Identify opportunities to improve energy and resource efficiency
  - Quantify and monitor the social, environmental and economic benefits of improved resource efficiency, including the health co-benefits
  - Improve knowledge sharing
- Pollution Knowledge Strategy
  - Understand activities that cause pollution and types of pollutants from activities
  - Understand how to determine the risk of unacceptable impacts to human and environmental health
  - Understand what drives and influences behaviour.

A.6 Outcome status for WPs and the Hub

Table A.2 shows the outcomes and KPIs (including KPI number) reported on for each WP and the Hub across all reports. This also shows the status of each KPI at the time of the most recent reporting on the KPI.

Table A.2 Outcomes and KPIs reported on for each WP and the Hub

Outcome	KPI	KPI #	Status
WP1			
Partnerships and knowledge exchange underpins landscape fire management policy development, decision-making and evaluation	Policies, systems or operations developed and/or updated through information from the Hub	3	On Track
Scientifically rigorous information informs and meets OEH, CCF and partner priorities	Hub projects inform and meet: OEH Knowledge Strategies, CCF Objectives or EBMP Objectives	5	On Track
Productive partnerships build research capability and support knowledge exchange	Established and held working group meetings, annual conference	10	On Track
Mapping and monitoring fire regimes across all NSW ecosystems is revolutionised and automated	Online fire regime interfaces & tools launched. Fire regime automation and decision support systems implemented. FireTools Launched, fire history and climate data in progress	13	On Track
Holocene fire regimes are quantified and better understood	Fire regime statistical analysis planning	15	On Track
WP2			
Reputation and research capabilities leverage greater investment and deliver research	Leverage research from OEH funds achieved and Program completed	4	On Track
Scientifically rigorous information informs and meets OEH, CCF and partner priorities	Hub projects inform and meet: OEH Knowledge Strategies, CCF Objectives or EBMP Objectives	5	On Track
Research information and data are readily available in forms that different target groups can access, easily understand and use	Media interviews, Conversation articles.	6	On Track
Productive partnerships build research capability and support knowledge exchange	DPIE/NPWS staff assigned and involved in each WP from start to finish, PhDs established, host researchers and OEH/NPWS staff co-located	10	On Track
Predictive modelling for fuel types and flammability accounting for multiple scales in environmental variation across NSW is developed and integrated	Reporting milestones	14	On Track
Peer-reviewed research papers	Hub SC approved research papers submitted	17	On Track
WP3			
Scientifically rigorous information informs and meets OEH, CCF and partner priorities	Hub projects inform and meet: OEH Knowledge Strategies, CCF Objectives or EBMP Objectives	5	On Track
Productive partnerships build research capability and support knowledge exchange.	Working with end users.	10	On Track
Fire management's ability to mitigate GHGs and protect carbon stock is quantified and better understood	Reporting on milestones	16	On Track
WP4			
Reputation and research capabilities leverage greater investment and deliver research	3:1 leverage research from OEH funds achieved and Program completed	4	On Track
Scientifically rigorous information informs and meets OEH, CCF and partner priorities	Hub projects inform and meet: OEH Knowledge Strategies, CCF Objectives or EBMP Objectives	5	On Track

Outcome	KPI	KPI #	Status
Research information and data are readily available in forms that different target groups can access, easily understand and use	Identified target groups of Hub agree they have access and can understand and use information Media interviews, public presentations	6	On Track
Planned burning strategies which will have least impact on air quality and reduce risks to threatened biodiversity are defined	Strategies are defined, summarised and disseminated to target groups.	7	On Track
Productive partnerships build research capability and support knowledge exchange.	DPIE/NPWS staff assigned and involved in each WP from start to finish, PhDs established, host researchers and OEH/NPWS staff co-located	10	On Track
WP5			
Reputation and research capabilities leverage greater investment and deliver research	Leverage ongoing research and collaborations from OEH funds to win other grants	4	On Track
Research information and data are readily available in forms that different target groups can access, easily understand and use	Hub projects inform and meet: DEPI Knowledge Strategies, CCF Objectives or EBMP Objectives Cultural burning groups, agencies and stakeholders are using and implementing the information.	6	Complete
Influences of cultural burning on cultural revitalisation and wellbeing of Indigenous people, and the wider community is better understood	In-depth fieldwork and relationships enable a better understanding of the links between cultural burning, cultural revitalisation and wellbeing. New insights, methods and relationships with Aboriginal people allow the health and other benefits of cultural to be defined and measured	8	Complete
Productive partnerships build research capability and support knowledge exchange.	Indigenous people are actively engaged in the research process as partners to ensure the process and outcomes are beneficial to them. The experiences, views and needs of Indigenous people are used to build and enhance Indigenous cultural burning capacity. The experiences, knowledge and benefits of Aboriginal people are used to be build and enhance cultural burning capacity	10	Complete
Research is utilised by DPIE and becomes crucial for their day to day operations	New opportunities and positions become available within DPIE	NA	Complete
WP6			
Costs, benefits and implications of managing fire risk are better understood within agencies and by the public and facilitate change	Optimal, cost-effective approaches for planned burning defined. New strategies for planned burning for the future delivered to direct stakeholders and implemented Production of revised project plan following consultation and discussion	1	On Track
Scientifically rigorous information informs and meets OEH, CCF and partner priorities	Hub projects inform and meet: OEH Knowledge Strategies, CCF Objectives or EBMP Objectives	5	On Track
Research information and data are readily available in forms that different target groups can access, easily understand and use	Media Release	6	On Track
Productive partnerships build research capability and support knowledge exchange.	OEH/NPWS staff assigned and involved in each WP from start to finish, PhDs established, host researchers and OEH/NPWS staff co-located Wide ranging research end-user interactions	10	On Track
Peer-reviewed research papers	Hub SC approved research papers submitted	17	On Track

Outcome	KPI	KPI #	Status
Hub			
Costs, benefits and implications of managing fire risk are better understood within agencies and by the public and facilitate change	Optimal, cost-effective approaches for planned burning defined	1	On Track
Partnerships and knowledge exchange underpins landscape fire management policy development, decision-making and evaluation	Count of policies and operations developed and updated through information from the Hub	3	On Track
Reputation and research capabilities leverage greater investment and deliver research	3:1 leverage research from OEH funds achieved and program completed	4	On Track
Scientifically rigorous information informs and meets OEH, CCF and partner priorities	Hub projects inform and meet: OEH Knowledge Strategies, CCF Objectives or EBMP Objectives	5	Off Track
Research information and data are readily available in forms that different target groups can access, easily understand and use	Identified target groups of Hub agree they have access and can understand and use information	6	On Track
Planned burning strategies which will have the least impact on air quality and reduce risks to threatened biodiversity are defined	Strategies are defined, summarised and disseminated to target groups	7	On Track
Productive partnerships build research capability and support knowledge exchange	Hub Steering establish objectives and meet biannually	10	On Track
Productive partnerships build research capability and support knowledge exchange	OEH/NPWS staff assigned and involved in each WP from start to finish, PhDs established, host researchers and OEH/NPWS staff co-located	11	On Track
Productive partnerships build research capability and support knowledge exchange	Knowledge Exchange funded and SC approve and endorse: project plan, OEH communication and engagement strategy, Host Communication Plan	12	On Track
Mapping and monitoring fire regimes across all NSW ecosystems is revolutionised and automated	Online fire regime & interface tools launched. Fire regime automation and decision support systems implemented	13	On Track
Holocene fire regimes are quantified and better understood	Regimes are quantified, summarised and disseminated to target groups	15	On Track
Peer-reviewed research papers	Hub SC approved research papers submitted	17	On Track
Accessible and well-disseminated research	Hub SC endorsed OEH communication and engagement strategy is adhered to	20	On Track
Regular reporting of performance and governance	Progress and Final Reports approved by Hub and SC	21	On Track

Source: WP progress reports 1-8

Table A.3 shows the KPIs that are not reported on across any progress or status report for any WP or the Hub.

Table A.3 KPIs not reported on across the WPs and the Hub

WPs	Hub
KPI 2: New strategies for planned burning for the future delivered to direct stakeholders and implemented	KPI 2: New strategies for planned burning for the future delivered to direct stakeholders and implemented
KPI 9: Identified changes are listed, summarised and disseminated to target groups.	KPI 8: Influences are summarised and disseminated to 100% of target groups.
KPI 11: OEH/NPWS staff assigned and involved in each WP from start to finish, PhDs established, host researchers and OEH/NPWS staff co-located	KPI 9: Identified changes are listed, summarised and disseminated to target groups.
KPI 12: Knowledge exchange funded and SC approve and endorse: project plan, OEH communication and engagement strategy, Host Communication Plan	KPI 14: State-wide models of fuel, moisture and carbon dynamics developed. Fuel, moisture and carbon forecasting capacity implemented and integrated.
KPI 18: Data Management Plan approved by Hub SC. Data stored, version controlled with metadata	KPI 16: Management's ability is quantified, summarised and disseminated to target groups.
KPI 19: Direct involvement stakeholders agree they receive timely advice and recommendations from the Hub and the Project Manager	KPI 18: Data Management Plan approved by Hub SC. Data stored, version controlled with metadata
KPI 20: Hub SC endorsed OEH communication and engagement strategy is adhered to.	KPI 19: Direct involvement stakeholders agree they receive timely advice and recommendations from the Hub and the Project Manager
KPI 21: Progress and Final Reports approved by Hub SC	

Source: WP progress reports 1-8

Stakeholder engagement B

Table B.1 lists the stakeholders consulted for the evaluation. At the time of writing the draft report a total of 28 stakeholders had been consulted in 23 interviews.

Notes were recorded during interviews to enable qualitative thematic analysis. Stakeholders were provided with a discussion guide.

Table B.1 Stakeholders consulted

Stakeholder group	Number of stakeholders
Department staff, i.e. – Department (Applied Bushfire Science Program, Fire & Cultural Science, Climate Change & Sustainability, Climate & Atmospheric Science) – RFS (Predictive Services) – NPWS (Fire and Incidents)	5
Hub staff, i.e. – Hub directors – WP leaders – WP researchers	13
Beneficiaries and users, i.e. – NPWS (Fire and Incident Management, Park Operations Coastal, Conservation Aboriginal Partnerships) – Department (Science Economics Insights, Conservation Sustainability, Aboriginal Strategy and outcomes, Fire Planning Manager, Applied Bushfire Science Program) – RFS	10

Source: ACIL Allen

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