



National Environmental Science Program

National Environmental Science Program

Sustainable Communities & Waste Hub
annual progress report 1 January 2022 to
31 December 2022



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Acknowledgement of Country

We acknowledge the Traditional Owners of Country throughout Australia and their continuing connection to land, sea, sky, and community.

We pay our respects to them and their cultures and to their Elders past and present.

Our Indigenous research partnerships are a valued and respected component of National Environmental Science Program (NESP) research.

Letter from the Hub Leader

This report provides our second update on the progress of the Sustainable Communities and Waste Hub from 1 January 2022 to 31 December 2022.

The Sustainable Communities and Waste Hub is funded by the Australian Government under the National Environmental Science Program (NESP) and aims to deliver high quality research that improves outcomes for Australia to reduce the effects of plastic, support sustainable people-environment interactions and offer options to minimise impacts of hazardous substances and air pollutants, using its cutting-edge technical capabilities, particularly in the fields of waste and materials processing.

We aspire to:

- create more sustainable communities and reduce waste impact through innovative, participatory, and circular-based planning, design, and supply-chains.
- transform waste materials via new science to form the foundation of scalable, local waste to value solutions that are industry, research-user focussed.
- embrace reconciliation and greater caring for our unique ecosystems by working with our First Nations Peoples to build enduring relationships and sustainable communities.
- improve environmental and wellbeing outcomes through better management of waste, pollution, air quality, and promotion of nature-based solutions and nature connection.
- increase prosperity and jobs creation by aligning and boosting Australia's recycling and manufacturing capacity.

In our second year of operation, we have moved from co-design to implementation and collaboration with our research-users under three themes – sustainable communities, remote and regional solutions and waste resources. A number of significant and important projects have kicked off across these focus areas, tackling some challenging research and knowledge gaps and providing potential solutions for Australia. Our Hub, first and foremost is ensuring that the work we deliver meets the needs of our research-users and will provide an impact pathway to solving some of the issues facing Australian communities around liveability and nature connection, air quality, waste management and recycling and circular economy. One such project completed this year has seen the Hub working with the Department of Climate Change, Energy, Environment and Water to inform the development of a framework of environmental indicators linked to the wellbeing and productivity of Australians. This work is informing the work being undertaken by Treasury on “Measuring what matters for progress and wellbeing”.

Looking ahead over the next 12 months as projects mature, other key outcomes will become evident across our three themes, particularly relating to regional and remote waste recycling solutions, microplastics, air quality effecting Indigenous health and local communities, hazardous substances, circular economy solutions and liveability and nature connectedness.

The Hub's website and social media channels continue to provide good opportunity to share the stories and learnings from research project progress, impacts, and outcomes with the broader community.

I am personally very excited about the next phase of the Hub which will see the continuation of our research projects in 2023, to help us deliver more sustainable communities and better waste management outcomes.

Yours sincerely

Prof Veena Sahajwalla, Hub Leader

Management

The Sustainable Communities and Waste (SCaW) Hub is a consortium comprising five world-class research institutions led by the University of New South Wales, Sydney (UNSW). They include the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Monash University (Monash), the University of Tasmania (UTas) and Curtin University (Curtin). The Hub provides a collaboration space for academics, government, industry and the community, with the shared objective of enhancing sustainable community outcomes and reducing negative waste impacts.

Our research agenda is co-designed with the Department and other research-users at all levels of government, industry, non-government organisations (NGOs), national associations and Indigenous and other community groups in urban, regional and remote Australia.

Our Hub Vision is to improve the health, resilience, connectedness and prosperity of urban, regional and remote communities across Australia, with reduced impact on the environment (Figure 1).



Figure 1: SCaW Hub's Vision

The SCaW Hub embarked on its second year in 2022, following an initial year of establishing contractual agreements, operational structures, and co-designing research projects with stakeholders and research-users. This year, major projects commenced across all themes. In addition, the Hub addressed the first Emerging Priority research priority identified by the Department. Governance processes and operating systems introduced in year 1, continued to be strengthened and refined, with the Hub Leadership team continuing to work with IP Leads to ensure each IP had the support needed to implement research in accordance with timeframes set.

There were some changes to personnel within the Hub (refer to Figure 2). On 1 February 2022, CU's nomination of Mandy Downing as the new Senior Indigenous Facilitator was accepted, and CU also advised the Hub that it had changed Node leader to Dr Atiq Zaman. UNSW's Farshid Pahlevani stepped into the role of Knowledge Broker to replace UTas' Dave Kendal in July 2022. UNSW's Anirban Ghose was selected as the Data Wrangler and Strategic Designer Lucy Klippan joined the Hub to support Knowledge Brokering. In November 2022, Cheryl Batagol stepped down from her role as Steering Committee Chair, and was replaced by Michael Sharpe, who has extensive experience in

advanced manufacturing industries. Melita Keywood also stepped away from her role as IP4 co-lead, to be replaced by CSIRO's Amanda Wheeler. Malcolm Eadie also stepped away from his role as IP1 co-lead and Paul Satur from Monash University replaced him. A key team member from IP1, Dave Kendal also stepped away. In December 2022 Scientia Professor Deo Prasad stepped down from Hub Manager role. These changes in personnel did not however, impact on the ability of the Hub to continue to deliver against its RP2022.

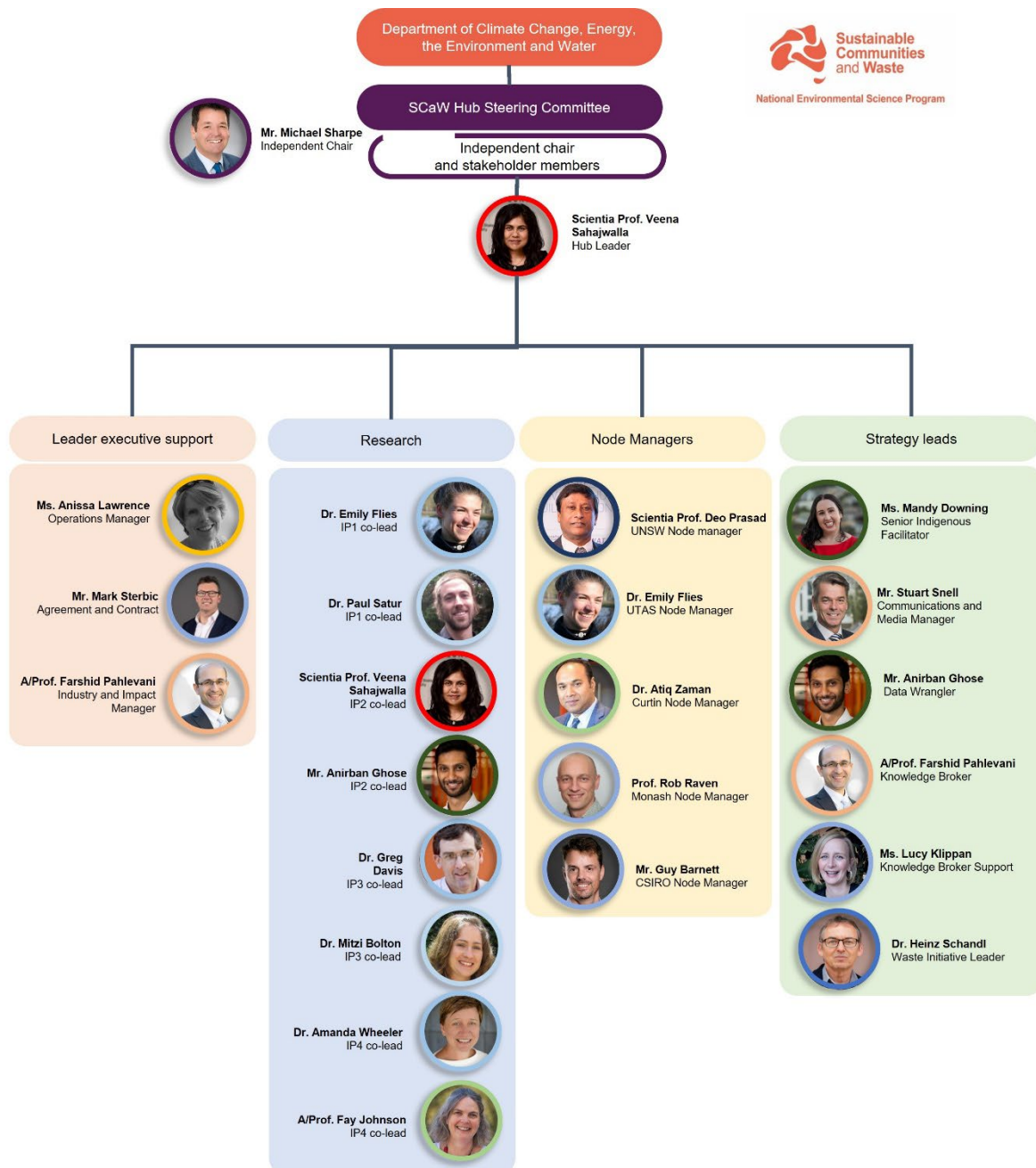


Figure 2: 2022 SCaW Hub Operational and Governance Structure

Research

NESP hubs deliver world-class, practical, evidence-based research to inform decisions. This investment helps build adaptation capacity and resilience in our natural environment and communities.

NESP research has real impact through partnerships and collaboration between researchers and research-users, including policymakers, to deliver proven outcomes. Environmental decision-makers are key partners and are encouraged to articulate their needs to researchers; provide feedback on the quality and usefulness of the research outputs; and be engaged in the communication of how this information has informed policy.

NESP research listens to and prioritises the research needs of Indigenous land and sea managers, weaves together Indigenous and western environmental knowledge systems and celebrates Indigenous-led approaches to strengthening and sharing knowledge.

New and existing NESP research findings are available to use and are accessible via Australian Government and hub websites.

Key Thematic Areas

SCaW Hub research impacts across three thematic areas (Figure 3):

- **Sustainable Communities** explores ways to enhance and inform sustainable social outcomes, policy and cultural challenges, and the health, wellbeing and liveability of Place, including what is needed to protect, preserve and increase prosperity.
- **Waste Resources** explores the ways that materials, such as microplastics, tyres and e-waste can be recovered and revalued through innovative technological solutions and helps to provide a better understanding of waste flows through society.
- **Remote & Regional Solutions** explores how place-based, fit-for-purpose solutions can be developed as a response to local needs, in remote and regional communities as well as urban across Australia. It focuses on building economies of purpose rather than purely economies of scale.

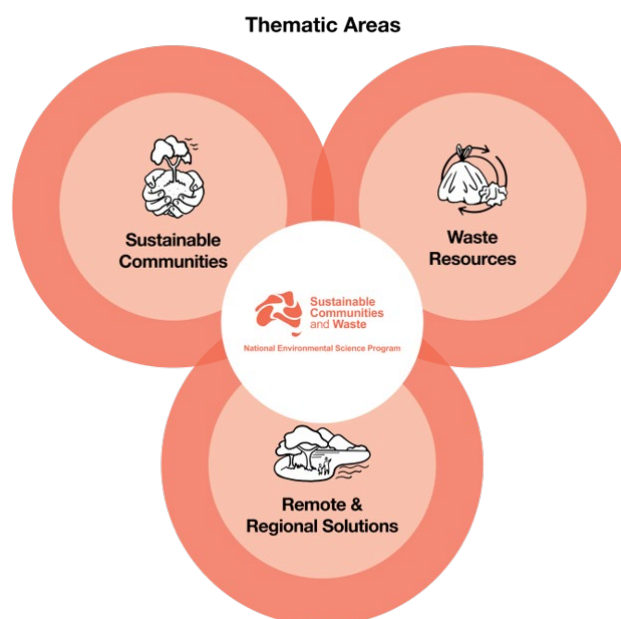


Figure 3: SCaW Hub 3 Key Thematic Areas

The SCaW Hub has five Impact Priority (IP) Areas that collectively deliver outcomes against our three thematic areas. Each of these IP areas comprises several research projects, identified and then developed through co-design during RP2021 and RP2022, led by collaborations of researchers across institutions. Each of the projects are briefly outlined in Figure 4, with more detail provided in Attachment A.

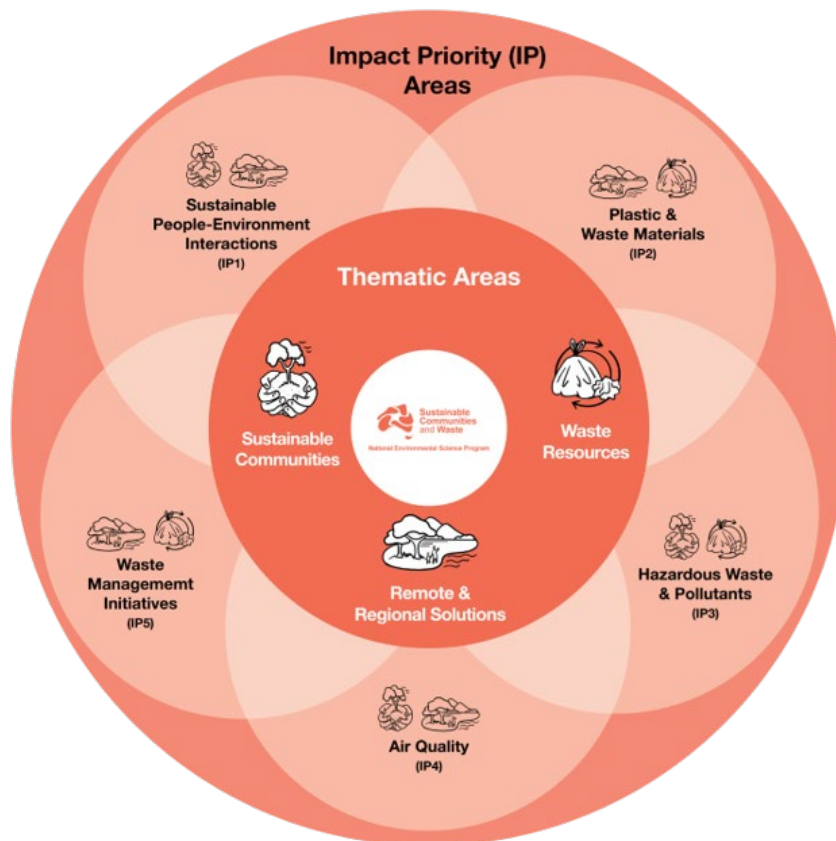


Figure 4: SCaW Hub 3 Key Thematic Areas and 5 Impact Priority (IP) Areas

IP1.02 - Sustainable People–Environment Interactions

Description

IP1 explores links between human wellbeing, and environmental and ecosystem health. Through research and collaboration and using a Nature-based Solutions (NbS) lens, this research is developing knowledge and tools to inform and stimulate change for the shared benefit of humans and nature.

This Impact Priority area aims to empower regional, remote and Indigenous communities to become more sustainable and their areas liveable. It is also supporting delivery of *Australia’s Strategy for Nature 2019–2030*, *National Climate Resilience and Adaptation Strategy 2021–2025*, and a renewed *National Water Initiative 2004*.

Thematic Areas

- Sustainable Communities
- Remote & Regional Solutions

Key Projects

IP1.02.01: Nature connection

The Nature Connection Project aims to increase benefits for humans and the environment derived from valuing nature, through understanding nature connection in the Australian context, and identifying and supporting strategies to maximise positive impacts on health, wellbeing and sustainability for all Australians.

IP1.02.02: Water sensitive and liveable communities

This research seeks to support regional and remote communities and their local institutions to develop more effective ways to empower their voice and sovereignty in decisions that impact on their way of life, especially around areas such as water management.

IP2.02 – Reduced Impact of Plastics and Other Materials

Description

IP2 seeks to develop innovative solutions to mitigate the negative impact of problematic materials on the environment. The outcomes of this research are expected to have implications for the waste management industry, policymakers, and society at large. By developing innovative solutions that address the negative impact of waste materials, IP2 aims to promote cleaner and healthier environments while contributing to a more sustainable future.

IP2 researchers are guided by national priorities including, "The National Waste Policy 2018" and the "2019 National Waste Policy Action Plan" and supported by further plans including modernisation of recycling and manufacturing capability and sustainable protection of national materials supply (critical materials).

Thematic Areas

- Waste Resources
- Remote & Regional Solutions

Key Projects

IP2.02.01: Understanding Microplastics

This project seeks to address the concerns raised by councils, industry, governments and communities over microplastics and component materials to directly address gaps on the prevalence and impact of microplastic pollution. This includes understanding the sources and generators of microplastics and the development of a national protocol for measuring and monitoring microplastics, providing deeper insights for policy.

IP2.02.02: Finding fit-for-purpose technological recycling solutions for regional and remote communities across Australia

This project seeks to identify and trial fit for purpose technological recycling solutions, utilising hub and spoke models for remote, and regional communities across Australia. Several case studies will provide the ground-truthing for solutions and provide lessons learned and stories to build the capacity of other communities.

IP2.02.03: Plastic-reinforced artificial reef structures: improving understanding

Many artificial reefs have been deployed in Australian waters, often for fisheries or tourism enhancement. The Department has issued a draft interim policy, "Plastics in Artificial Reefs", seeking to develop purpose-built artificial reef guidelines. This project provides guidance to inform the policy, by summarising the latest research and information available on the use of plastic reinforcement in artificial reefs.

IP3.02 – Management of hazardous waste, substances and pollutants

Description

Chemicals in our waste streams pose undefined risks, which inhibit our ability to safely move towards achieving national and state policy action targets to divert materials from landfill and accelerate reuse. The presence of chemicals of potential concern (CoPC) can impact recyclability of waste and the safe reuse of materials in the economy, and the establishment of robust circular economies. Through the generation of high-quality data related to the mass and potential availability of chemicals in our waste streams, this project will assist safe recovery and reuse of resources obtained from wastes and enable national resource recovery targets, by bridging the gaps in knowledge that allow adequate risk characterisation.

Thematic Areas

- Waste Resources
- Sustainable Communities

Key Projects

*IP3.02.01: Understanding chemicals of concern in our wastes and recovered resources
(Subsequently renamed in RP2023 as Quantifying mass and potential release of chemicals of potential concern in our wastes and recovered resources)*

Using waste tyres and e-wastes as the initial target waste streams (case studies) through a multiyear project, this project seeks to build national capability and generate quantitative data and methodological guidance that can be used for evidence-based risk management of CoPC identified in waste and repurposed materials. In this first year, the project will build a knowledge platform for concentrations of CoPC in waste streams and develop robust and representative sampling, waste characterisation and reporting methods.

The project seeks to generate data that are discoverable, accessible, and reusable, and can easily be integrated and interpreted for other applications, to inform risk-based decisions regarding the management, treatment, and safe reuse of these wastes.

IP4.02 – Improved Air Quality, Forecasting and Assessment

Description

While air quality in Australia is generally good, significant health impacts continue from bushfire smoke, planned burns, wood-heaters, and local industrial pollution. IP4 explores how to reduce air pollution and its impacts in Australia.

Thematic Areas

- Remote & Regional Solutions
- Sustainable Communities

Key Projects

IP4.02.01: Let's talk about smoke (subsequently renamed in RP2023 as Let's yarn about smoke)

Bringing together practitioners from air quality, Indigenous health, and fire and land management domains with government and community stakeholders, this project aims to learn from, and where possible, support existing Indigenous-led actions towards improving air quality and health. It also seeks to identify opportunities to co-design air quality research, resources and tools that address Indigenous identified priorities for managing the impact of landscape smoke on the health of communities.

IP4.02.02: How will a changing climate and emissions reduction measures impact sources of air pollution and secondary pollutant formation?

The project is a modelling study to provide a lens on how altered we can expect air quality to be under future emission scenarios in Australia. It will leverage modelling capability in the Climate Systems Hub and will contribute to cross hub Initiative activities. The research outcomes will be used by government agencies for managing future changes to air quality and health.

IP4.02.03: Wood-heaters: developing and testing novel solutions to a persistent problem.

This multi-year program aims to implement and evaluate novel solutions to wood-heater emissions to directly inform policy and support the scaling up of successful interventions.

IP4.02.04: Evaluation of interventions to reduce air pollution in safe havens and use of Low-Cost Sensors to identify areas of concern.

This project aims to provide up-to-date guidance on the choice and use of low-cost sensors and HEPA filters in the Australian context. Part of this project will include working with manufacturers to develop plain-English education material and programs to ensure research-users understand the capacities and limitations of these technologies.

IP5.02 Waste Impact Management Initiative

Description

IP5 focuses on providing information, data and management tools; informing design for repurposing waste and circular economy; informing the institutional and governance needs of community-based resource recovery and circular economy initiatives; and waste management and resource recovery opportunities for Indigenous communities.

Thematic Areas

- Waste Resources
- Remote & Regional Solutions

Key Projects

IP5.02.01 - Australian Metrics for Materials, Waste and Resource Recovery summarised in a Circularity Gap Report and Dataset

This project will prepare the first Australian Circularity Gap report based on a comprehensive material flow analysis of the Australian economy whole of life cycle, including domestic and international flows. The Circularity Gap report will show the level of recycling and circularity of the Australian economy and establish a baseline for further efforts of businesses and government to build a circular economy.

IP5.02.02 - Exploring Opportunities for Increasing Value Recovery from used Tyres and Conveyor Belts in Western Australia

This project aims to generate data on the current generation of tyre and conveyor belt waste and their management and identify strategies to enable higher value recovery from these resources in WA by redirecting waste to resource recovery. It will also address challenges related to logistics and cost, to guide investment and policy decisions.

IP5.02.03 - Governing Community Based Resource Recovery and Circular Economy Initiatives

This project seeks to develop a model for networked circular economy (CE) governance best suited to supporting regional CE in Australia. This research complements the information sharing role of the Australian Circular Economy (ACE) Hub's local government portal with knowledge generation on fit-for-purpose networked governance. By proto-typing and developing tools and responses to this challenge, the project seeks to fill gaps to help advance practical outcomes on the ground. The project will extend existing local government networks of regional CE stakeholders and provide a platform to facilitate future CE collaborations between different local government areas that also links regional community-led initiatives with state and national government initiatives for CE.

IP5.02.04 - Scoping study creating opportunity from waste in Aboriginal communities in Western Australia

This project seeks to work with Aboriginal communities to identify the magnitude and characteristics of local waste problems and explore potential opportunities for managing waste, recovering resources, and creating economic and employment opportunities.

IP5.02.05 – Place-based cross hub integration project

This project aimed to work with the three other Hubs to identify two locations for a place based cross Hub research initiative including an analysis of local issues and research priorities for every Hub.

Progress towards research delivery

IP1 – Sustainable people–environment interactions (led by UTAS and MU)

Both projects moved from co-design to implementation this year, working with partners and collaborators to address research-user priorities.

IP1.02.01: Nature connection

The *Nature Connection Project* aims to increase benefits for humans and the environment derived from valuing nature, by understanding nature connection in the Australian context, and identifying and supporting strategies, like Nature-based Solutions (NbS), to maximise positive impacts on health, wellbeing and sustainability for all Australians. The focus for this year was on two key activities - the Nature Connection Storytelling Project (NCSP) and the Nature Connection National Survey (NCNS) as well as providing research to inform urban greening policies. These projects were co-designed with

input from several divisions across the Department including Biodiversity Policy section, Migratory Species, Parks Australia, and other partners. These included state departments (e.g. Victorian Department of Environment, Land, Water and Planning; DEWLP), and local governments (e.g. Launceston and Brighton Councils in Tasmania), non-governmental organisations (Landcare Tasmania, Conservation Volunteers Australia) and Indigenous organisations (e.g. melythina tiakana warrana Aboriginal Corporation; MTWAC), among others. In 2022 outputs produced included reports from co-design workshops and a Fact Sheet on the benefits of connecting with nature. Work also commenced on the development of the NCSP and NCNS.

As a starting point for creating a nation of people who value nature, we need to build a baseline understanding of what valuing and connecting to nature means to Australians. We also need to explore what enables or hinders nature access and/or experience, and the mechanisms that generate the desired benefits. The NCNS seeks to answer the following research questions:

- What are the characteristics of nature connection across Australia?
- In what ways does connecting with nature increase or activate people's values for nature, motivate pro-environmental/sustainability behaviours and impact wellbeing?
- How do these relationships vary across Australian geography, demography and green space types?

In response to consultation and research, the NCSP seeks to:

- Develop a repository of stories about nature connection and its impacts, and a national nature connection story map, initially piloted in Tasmania
- Create an accessible platform for gathering and sharing stories of nature connection
- Work with partners to gather stories in a range of forms (written, oral, visual) that collectively demonstrate a diverse variety of experience, impacts and implications
- Conduct qualitative research on these story forms to understand what nature and nature connection means more deeply to Australians.

From this body of creative work, the focus in 2023 will be on analysis, characterisation, mapping and communicating of outcomes for what nature means to Australians by documenting and articulating how we value nature.

An examination of urban greening was also undertaken in 2022. Urban greening can be a NbS for climate adaptation and nature connection in cities. We explored public perceptions of its value in a local context by conducting workshops with the City of Launceston (Tasmania) and diverse stakeholders and communities to understand public perception of urban greening and inform council greening activities and strategy across Australia.

Our research is supporting reporting on Australia's Strategy for Nature, and, by linking nature with health and wellbeing, Australia's State of the Environment. What we learn about nature connection and its benefits across the country will support the development of environmental policies and strategies that have co-benefits for people and nature. Outcomes from our investigations into the scaling up and out of NbS can improve sustainability and liveability across the country including into regional, remote and Indigenous communities.

IP1.02.02 Water Sensitive and Liveable Communities

This project seeks to establish contextually and culturally sensitive pathways that support water and liveability outcome for remote and regional communities. There is a clear and urgent call in the national discourse for research to support regional and remote communities and their local institutions

to develop more effective ways to empower their voice and sovereignty in decisions that impact their way of life.

The following key research questions were identified as priorities during the co-design process in 2021 and 2022 with the Department and other research-users:

1. What co-designed research is needed to address research-user identified and prioritised gaps in knowledge capital and improvements to existing knowledge products that can be scaled out to benefit regional and remote communities?
2. How can sovereign water rights, knowledges, practices, values and aspirations of Indigenous peoples transform water governance and scientific frameworks for better water outcomes for Country, culture and community? (Indigenous-led)

Accordingly, this project comprises two streams of work which commenced in 2022 that will be brought together over time to address the project aims.

Stream 1 seeks to improve access to fit for purpose knowledge capital and products for regional and remote communities and establish an authoritative national platform for accessing science, tools and guidance in ways that are contextually sensitive to the needs, aspirations and realities of remote and regional areas application. These outcomes will be achieved through:

- the evidence review (or “stocktake”) of existing tools and framework undertaken in 2022 and to be finalised for publication in 2023
- a qualitative user survey to understand local government practitioner needs in remote and regional settings, with design commencing in 2022
- workshops with leading state, local and community representatives to co-design functional requirements for a platform, planned for 2023
- a concept design for a ‘user centred’ approach, drawing on the workshop and research-user survey to inform the conceptual design and a methodological framework for a national platform to accelerate water sensitive transitions, reduce urban heat impacts and improve liveability.

Stream 2 seeks to develop an Indigenous-led evidence-based framework and models to structurally empower Indigenous voices and participation in decisions that impact on their rights of self-determination and on exercising their stewardship of Country. Planning for the following activities commenced in 2022:

- A three-workshop series with Indigenous scholars and Indigenous water practitioners to explore aqua nullius (workshop 1); Indigenous water science practices and governance (workshop 2); and strategies to negotiate the use of Indigenous science methods and water governance (workshop 3).
- A colloquium shaped by the above workshop with outcomes aimed at creating the conditions for an Indigenous-led review of the work required to transform the architecture of the Australian water sector, including legislation and institutions, to allow the re-enfranchisement of Indigenous water science and governance.
- A series of place based participatory action research and case studies of Indigenous led governance and institutional frameworks and models for Indigenous water outcomes.

Importantly, both research streams will seed new knowledge and practice that will be integrated in subsequent years to guide a systemic approach to water and liveability transformations in remote and regional communities.

While IP1.02.02 has successfully completed milestones 1-3 and 5, project progress in relation to Milestone 4: *A Concept Design and framework for national platform development* was slowed in late 2022 due to the emerging DCCEE priority for the establishment of an environmental indicator framework for community wellbeing. This initiative led to key personal (including the IP.02.02 project lead and Research Assistants) momentarily shifting their input away from the Milestone 4 delivery. Following this, a delayed ethics approval process (resulting from extensive backlog within the ethics department), and a shift in personal, including new Project Lead further contributed to slowed progress of this deliverable. This has resulted in a revised scheduling of Milestone 4 from March 2023 to August 2023 and results will be reported in the 2023 Annual Progress Report.

Importantly the project team are confident that the revised scheduling will not affect the commencement of RP2023 research priorities as these are not dependent on milestone 4 outputs being completed. Milestone 4 will inform future program design in RP2024-2025 stages.

IP2 - Reduced impact of plastics and other materials (led by UNSW and Curtin)

For 2022, the focus was on collaborating with industry and community groups, including both Indigenous and government, to find "*fit for purpose*" solutions towards addressing three key objectives:

1. Developing a national monitoring protocol informing national policy on microplastics and investigating material properties and characteristics for different waste materials contributing to the issue.
2. Investigating the trial of practical technological solutions to waste management challenges across regional and remote communities and providing ready access to information for stakeholders.
3. Informing policy development regarding the utility of plastic in artificial reef construction.

IP2.02.01 Understanding Microplastics

Research on microplastics and their potential threats to ecosystems and humans is in its infancy and is complex - a lot remains uncertain. However, growing scientific evidence on the hazards of the uncontrolled, irreversible, and long-term ecological risks due to microplastics do exist for some coastal waters and sediments. Scientists predict that if emissions to the environment continue at the current rate or increase, ecological risks could be widespread within a century. A key issue highlighted by the Department and other research-users through co-design activities in 2021 was the need for an improved understanding of the impacts of microplastics in Australia on the environment and species to guide policy and best practice management responses.

This year, the IP2 team delivered a research plan (RP2023) co-designed with the Department and key stakeholders. Through the workshops, the need for two key outcomes became evident - a national protocol of monitoring and measuring microplastic pollution and an understanding of additives and materials that accelerate or lead to microplastic generation.

In 2022, a key output was a foundational synthesis report on microplastics which will be further developed and socialised with the Department in 2023. The report highlights the complexity from a variety of analysis techniques and environmental matrices connected with microplastics. The team experimented with several technical analytical techniques used globally. This work highlighted gaps that the researchers can fill for microplastic analysis. The team will further collaborate with AUSMAP and Ocean Protect in 2023, in conjunction with the Department, to finalise the protocol for measuring and monitoring microplastics.

The team also created a document that brings together several international and national lists of materials of concern. This consolidated list will be converted into a data product in 2023 to be usable by stakeholders to minimise the impact of materials on “red” or “watch-lists”.

IP2.02.02 Finding fit for purpose technological recycling solutions for regional and remote communities across Australia

As defined using the Australian Statistical Geography Standard (ASGS) categorisation, regional and remote communities struggle with finding *fit for purpose* solutions to address fundamental waste problems. Regional and remote locations present unique challenges in managing waste, dealing with seasonal weather-driven isolation, and a lack of connection to major roads or towns. In many cases, regional and remote areas often lack kerbside waste collection and access to recycling and re-manufacturing centres. There has been significant work undertaken previously by several organisations to understand the complexities of the challenges and make recommendations for how best to address them.

Building on these findings and using the recommendations from previous studies on how to address waste in regional and remote settings, this multi-year sub-project seeks to identify and trial fit for purpose technological recycling solutions, utilising hub and spoke models for remote/very remote, inner and outer regional communities across Australia.

In 2022, the team collaborated to create a categorisation of waste demographics. This classification system was developed through co-design workshops with various stakeholders including the Department, councils, Indigenous groups, and community organisations. Working in collaboration with IP5, IP2 collaborated on design of a survey for councils that will be distributed in 2023 to collect valuable data for this project. To identify suitable communities for the project's development, the team created community profiles and shortlisted Bunbury and Shoalhaven for further exploration.

IP2.02.03 Plastic-reinforced artificial reef structures; improving understanding

This desktop-based project, completed during the year, undertook a review of scientific literature and interviews with experts on the environmental implications of the use of plastic reinforced concrete (PRC) for artificial reefs to inform the permit application process for purpose-built artificial reef structures.

IP3 - Management of hazardous waste, substances and pollutants (led by CSIRO and Monash)

The work aims to build national capability and generate quantitative data and methodological guides that can be used for evidence-based risk management of chemicals identified in our wastes and in repurposed materials. This year focused on building a knowledge platform for the chemical composition of key waste streams and associated concentrations. The work undertaken in 2023 will provide an indication of leachable components from these waste streams, and their behaviour under field or reprocessing conditions. Information sharing and hazardous waste governance will be enabled through improved baseline compositional and leachability data.

This year the project generated preliminary information regarding the chemical composition of key waste streams, including known chemicals and other components that may trigger further investigation based on preliminary risk assessments. Additionally, through a close co-design process with the Department, the following was delivered:

- A draft leaching methodology for application in 2023 under the next phase of research
- A preliminary guidance document for the robust and relevant sampling of complex waste streams

- A data management strategy with data reporting template that meets the requirements of research-users
- Leveraged strong collaborative ties within and outside the SCaW Hub with key research partners.

IP4 - Air quality, forecasting and assessment (led by UTAS and CSIRO)

While air quality in Australia is generally very good, we continue to see significant health impacts from bushfire smoke, planned burns, traffic, wood-heaters, and local industrial pollution. We understand government departments responsible for air quality, fire and public health urgently need better information for planning and response. Importantly, this information needs to be made available in a timely fashion and in forms that are usable by all, particularly for community members at higher risk because of their age, occupation, social disadvantage, or existing medical conditions.

During 2022, a range of activities commenced for each of the four projects being undertaken within IP4. All four projects provided proposals covering work to follow on in 2023 and in some instances the years beyond as well for approval by the Department. These research proposals were the only 2022 deliverable due for completion in 2022. Several meetings with the Department were undertaken to ensure project relevance. The projects were all continuations of the work prioritised in 2021.

Researchers in all four IP4 projects engaged in several virtual meetings with a range of stakeholders. As part of IP4.02.03 a wood-heater survey was distributed to stakeholders and completed by 70 individuals. This was followed by an interactive wood-heater workshop involving 140 participants representing 96 national organisations. The intent of the workshop was to evaluate support for a range of interventions to manage wood-heater emissions.

IP4.02.04 research activities progressed with the creation of decision tools for the selection of appropriate low-cost air quality sensors and the selection of air cleaners to reduce the impacts of poor air quality on indoor environments.

IP4 research activities were presented to national bodies including the Healthy Environment and Lives Network, and the Clean Air Society for Australia and New Zealand annual conference.

IP5 - Waste impact management initiative (led by CSIRO and MU)

Progress was made during 2022 on the four research projects developed in 2021 through stakeholder engagement and co-design.

Project IP5.02.01: Australian metrics for materials, waste and resource recovery summarised in a circularity gap report and dataset

This project seeks to enhance the knowledge base on how materials are managed in the Australian economy and to identify the potential for designing out waste, to keep materials in circulation and to conserve resources. This was addressed by developing a comprehensive material flow account for Australia and by establishing a set of circular economy indicators. The circularity report, as the final product will provide a dataset for material use, waste and emissions and presents indicators for reuse, recycling, and circularity. We will achieve a high-level of data granularity to address the policy needs of the Department and other stakeholders. We will also address the whole spectre of circular economy opportunities that exist across material supply chains and look at direct and embodied flows (i.e., footprints) to assess volumes managed in Australia and within Australia's international supply chains.

Implementation commenced in 2022 with additional research capability through a CSIRO top-up scholarship (for a PhD student at UNSW) and the CSIRO Impossible Without You program. The

research team engaged with several areas in the Department, including the newly formed circular economy team and the teams responsible for Waste Policy and the Waste Policy Implementation Plan. Bilateral engagement was also undertaken with state governments to ascertain their data needs and in the context of the Metrics Working Group of the Australian Circular Economy (ACE) Hub.

Several steps in the research process were completed in 2022, including:

- an Australian economic input-output table with detail for economic sectors and for all states and territories was sourced from the Australian Virtual Industrial Ecology Lab (IE Lab)
- the newest edition of the GLORIA global, multi-regional input-output table representing 120 economic sectors and all countries of the world was sourced from the literature
- the detailed Australian I-O table was integrated into the GLORIA global table (resulting in a nested structure) and the table was rebalanced to represent the global supply chains between industries
- a domestic extraction satellite for all countries in the world was sourced from the International Resource Panel online database and the Australian extraction data downscaled to states and territories
- a test run was undertaken to establish the material footprint accounts and to enable the analysis of material flows through the economic system from cradle to grave.

Project IP5.02.02: Exploring opportunities for increasing value recovery from used tyres and conveyor belts in Western Australia

This project was jointly funded by the Australian Government's National Environmental Science Program, Western Australian (WA) Department of Water and Environmental Regulation (DWER) Waste Authority and Tyre Stewardship Australia (TSA). Researchers explored opportunities for increasing value recovery from end-of-life tyres (EOLTs) and conveyor belts in WA. The approach included reviewing relevant regulatory and policy related to the management and disposal of EOLT, reviewing data on EOLT and conveyor belt arisings in WA on a regionally specific basis, and comparing the data with current and planned processing capacity. Gaps, barriers and opportunities were also identified for developing market potential for recycled materials produced from EOLTs and conveyor belts in WA. The report provides recommendations for state and national governments to improve value recovery from EOLTs and conveyor belts. Some of the recommendations are already being considered for amending controlled waste regulations. It is in the final stages of review by the Department.

Project IP5.02.03: Governing community-based resource recovery and circular economy initiatives

Key project objectives for 2022 were to:

- identify gaps in knowledge that the research can contribute
- develop a prototype networked governance model to support community-led Circular Economy (CE) and resource recovery activities in regional and remote Australia
- establish relationships with key partners for information sharing.

The focus was on initiating an internal NESP collaboration with IP2, and on engaging with relevant government organisations – including Sustainability Victoria and the Tasmanian Waste and Water Board.

During 2022, the following research activities were undertaken:

- literature review which focused on the role of local government in circular economy transitions and identified key gaps in regional and remote CE and resource recovery and around community led initiatives for CE and resource recovery

- completed situation reports for Ballarat and Bendigo (Launceston was completed in 2021) which provided a sound foundation for a lighter but more widely applicable assessment of current status and potential for network governance for CE across regional Australia
- desktop survey of consulting firms providing CE services to local governments across Tasmania and Victoria. Results highlighted the importance of understanding the character of existing services and the actors providing them, and the density of support required for facilitating CE via network governance. Questions relating to this will be incorporated in the 2023 survey
- recruitment of PhD student through UTas (to commence 30 June 2023).

Work undertaken in 2022, including the literature review, the desktop review and situation reports, will be captured in a peer reviewed publication to be submitted to the journal, *Local Environment*, in 2023.

Project IP5.02.04: Scoping study creating opportunity from waste in Aboriginal communities in Western Australia

Through a scoping study, this project, in close collaboration with the SCaW hub's Senior Indigenous facilitator and an Indigenous researcher, sought to:

- identify Aboriginal communities in Western Australia who would like to be involved
- engage in a process to identify the magnitude and characteristics of the local waste problem
- explore potential opportunities for managing waste, recovering resources, and creating economic and employment opportunities.

During 2022, the key challenges of waste management in the Aboriginal communities were analysed using available secondary data and reports. The project team identified limited resources, data and previous studies on waste management in the Aboriginal communities. The key component of the research engaging with local Aboriginal communities and identifying the key challenges and possible opportunities to address the waste problem and the activities are planned for 2023.

Researchers with Indigenous backgrounds who can collaborate in the project were identified during 2022. It is very important to maintain and follow appropriate protocols and procedure while conducting community engagement within the Indigenous communities. The project is being guided by the Aboriginal Terms of Reference (ATR) framework, a set of principles and core values which cover four dimensions: cultural knowledge, experience, understanding, and aspiration.

Since the Swan-Canning is one of the priority areas for cross-hubs collaboration, the Aboriginal communities in the Swan-Canning area have been identified as a representative community group. The project is currently in the process of recruiting a community engagement person with an Aboriginal background who can support the community engagement activities.

IP5.02.05 – Place-based cross hub integration project

IP5.02.05 provides an operating budget (to cover travel to meetings) for engagement with place based cross Hub projects which is an approach that was proposed by the Initiative leads and adopted by the Hub leadership group at the cross hub meeting in Canberra in 2022. Coordination of research activities between NESP hubs and Initiatives was undertaken by the Initiative leads of the four hubs who met monthly during the reporting period. This included meeting with the Department, to design the conceptual arrangements for cross-hub research and facilitate the necessary interactions between researchers from different hubs. The plan was to contribute to an initial assessment of two potential locations for placed based cross Hub activity and depended on coordination between the four Hubs which did not occur in the absence of a coordination mechanism. This is discussed in more detail under the Cross-Cutting Initiatives below.

Research projects

Attachment A lists the projects funded under the SCAW Hub and provides information on the project status, information on outputs and links to products for all projects (where available). Exceptions to the NESP data and information guidelines are also noted there.

The following table provides a summary of the progress for each major 2022 deliverable across IP areas and Hub:

Responsible IP Area	Deliverables/milestones	Date Completed	Status & Comments
Hub	Acceptance of Annual Progress Report 1 by the Department	1 April 2022	Annual progress report for 2021 accepted by Department
Hub	Delivery of draft Research Plan 2023 to the Department	23 September 2022	Research plan 2023 submitted to the Department on time
Hub	Acceptance of final Research Plan 2023 by the Department	23 October 2022	Research Plan 2023 accepted by Department
IP1.02.01	Signing of project contract	30 June 2022	Completed
IP1.02.01	Co-design workshops for RP2023 commenced	1 August 2022	Completed
IP1.02.01	Detailed project RP2023 developed	29 August 2022	Completed
IP1.02.01	Current State of Nature Benefits Report	28 February 2022	Connecting with Nature Fact Sheet produced and available in this link: The benefit of connecting with nature
IP1.02.02	Signing of project contract	30 June 2022	Completed
IP1.02.02	Co-design workshops for RP2023 commenced	1 August 2022	Completed
IP1.02.02	Detailed project RP2023 developed	29 August 2022	Completed
IP1.02.02	Conceptual design and framework for the development of a national platform to advance water sensitive communities and urban heat mitigation outcomes for regional and remote areas	31 March 2023	Project delays (to foregrounding information and workshops (refer explanation provided in section: Progress Towards Research Delivery) have meant this output has been rescheduled for delivery by 30 th August 2023
IP2	Codesign Workshops: <ul style="list-style-type: none"> – Recyclables in a mixed form – Clean Stream Recyclables – Recycled Materials – Market Ready Products 	30 March 2022	Workshops were successfully completed, engaging with multiple stakeholders.
IP2.02.01	IP2.02.01 inception meetings/discussions	30 July 2022	Completed
IP2.02.01	Plastic Additives Report	30 September 2022	The RP2022 report on plastic additives has been produced and circulated to the Department. It will be finalised in early 2023. This is part of a multi-year project and will be furthered in 2023
IP2.02.01	A progress report of findings to predict microplastic risk for EPBC Act-listed threatened species:	30 October 2022	Planning for a multistakeholder meeting is underway with RL Hub and MAC Hub as a cross

Sustainable Communities and Waste Hub annual progress report 2022

Responsible IP Area	Deliverables/milestones	Date Completed	Status & Comments
	Threatened Species Microplastic Risk Report		hub meeting. Literature report is informing the development of this workshop. This will occur in April/May 2023
IP2.02.01	A progress report on a nationally consistent monitoring system (protocol) and national database for microplastic pollution: Microplastic Monitoring Protocol Progress Report	30 October 2022	The report for this project has been finalised and will be socialised and further developed in 2023 as this is part of a multi-year project
IP2.02.01	Preliminary RP2023 Plan	23 September 2022	Completed
IP2.02.01	RP2022 Draft report submission	30 December 2022	Completed
IP2.02.02	IP2.02.02 inception meetings/discussions	30 July 2022	Completed
IP2.02.02	Fit-For-Purpose Technologies' Project Yearly Progress Report	30 October 2022	Multiple discussions with Department and other research-users have been undertaken and progress report for 2022 has been finalised and will continue to be developed in 2023 as per RP2023. Progress report will be submitted to Department once a Department research-user replacement has been identified
IP2.02.02	Preliminary RP2023 Plan	23 September 2022	Completed
IP2.02.02	RP2022 Draft report submission	30 December 2022	Completed
IP2.02.03	Plastic-Reinforced Reef Structures Report	21 October 2022	The final report was submitted on time and accepted by the Department
IP3.02.01	Signing of contract	1 July 2022	Completed
IP3.02.01	Scopes refined to agree type and locations of e-waste and tyre wastes	30 July 2022	Completed
IP3.02.01	Analytical methodologies outlined for evaluation	30 July 2022	This was completed in July 2022 through co-design between CSIRO and Curtin University analytical laboratories, with feedback from research-users at the Department
IP3.02.01	Circulation of draft priorities to include within RP2023 – leaching and availability studies	1 August 2022	Completed
IP3.02.01	Sampling strategy for waste types drafted	31 August 2022	A draft sampling guidance for complex waste characterisation using end-of-life tyres as a case study was prepared in January 2022. The draft document was provided to research-users at the Department for comment in February 2022
IP3.02.01	Analytical update for characterisation of chemicals in wastes	1 October 2022	Samples were obtained to commence analytical work and to fast-track method development and sampling guidance material.

Responsible IP Area	Deliverables/milestones	Date Completed	Status & Comments
			A preliminary analytical update was provided on 25 October 2022, and a fuller analysis was prepared and submitted to research-users at the Department on 14 February 2023. There have been delays associated with securing additional samples from waste management and recycling companies.
IP3.02.01	Methodology for determining total leachable components	1 October 2022	A draft methodology for determining total leachable components in waste samples for use in RP2023 and beyond was prepared and sent to research-users at the Department for comment on 14 February 2023
IP4	Contract signing	1 July 2022	Completed
IP4	RP2023 proposal	23 August 2022	Completed
IP4	Contribution to RP2022 Annual Summary Report including progress on the outputs listed in the Pathway to Impact Table: IP4 Research Synthesis Report	28 February 2022	Completed
IP5	Principles for Australian Circular Economy Metrics	4 April 2022	Several outputs were delivered
IP5.02.04	Indigenous stakeholders and engagement approach	30 September 2022	Draft Aboriginal Terms of Reference (ATR) framework developed and circulated to research-users for feedback. Will be finalised in quarter 1 2023
IP5.02.04	Location Shortlist	30 September 2022	Shortlist of communities identified
IP5.02.01	Material Flow Dataset for Australia	1 December 2022	Progress made with several key aspects completed. This will progress in 2023
IP5.02.02	Report on regulatory and policy settings, environmental impacts of tyre and conveyor belt disposal, material flow and processing capacity analysis for used tyres and conveyor belts in WA and evaluation of market potential for products derived from used tyres and conveyor belts.	14 October 2022	Draft report sent to WA Department of Water and Environmental Regulation and tyre Stewardship Australia for feedback

Cross-cutting initiatives

The Waste Impact Management Initiative Strategy was endorsed by the SCaW Hub Steering Committee on 22 February 2022.

Coordination of research activities between all NESP hubs and Initiatives was undertaken by the Initiative leads of the four hubs who met monthly during the reporting period to design the conceptual

arrangements for cross-hub research and facilitate the necessary interactions between researchers from different hubs. The Department participated in these discussions. A whole of NESP meeting was held with all hub leaders and initiative leaders in Townsville and then again in Canberra during 2022 to progress cross-hub research.

Key cross-hub activities the Waste Impact Management Initiative Lead participated in included:

- development of a conceptual framework exploring the linkages between the thematic areas of the four Hubs that integrates the economy, people and the environment and builds on social-ecological systems theory and the DPSIR (driving force, pressure, state, impact response) framework
- working to identify place-based cross-hub research projects that bring the scientific capabilities of all four Hubs and initiatives to resolve local issues through interdisciplinary research and foster conceptual integration and shared impact among the NESP hubs
- working to incorporate international processes into cross-hub research to address the triple environmental crisis of climate change, biodiversity loss and waste and pollution and building links to Intergovernmental Panel on Climate Change (IPCC), Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and International Resources Panel (IRP) assessment processes
- contributing to international and Australian efforts of designing a circular low-carbon economy and providing scientific insights for the development of circular economy policy in Australia
- facilitating bilateral research projects with other hubs as identified in the Waste Impact Management Initiative Strategy.

As at the end of 2022, a consensus had not been reached about the focus of a cross-hub integration project, however some agreement was reached with respect to the Swan-Canning catchment in Western Australia being a focal place. Further discussions are planned for 2023. The success of the Initiatives and the work of the Initiative lead cohort needs to be further strengthened in 2023 by a coherent governance framework of research integration within the NESP program.

Bilateral cross-hub initiative opportunities discussed during 2022, some of which have progressed as outlined below, included:

- contamination pathways and environmental implications of materials leaking into ecosystems (land and water) impacting on human and ecosystem health (with RL)
- the role of microplastics in water and oceans and resultant ecosystem and food chain implications (with MAC)
- the role of built and living infrastructure in cities and regional areas for mitigating the adverse impacts of climate induced environmental disasters (e.g., infrastructure decisions in cities that mitigate heat, nature-based solutions to mitigate the effects of flooding) (with RL)
- the waste implications of climate impacts from for example, floods, storm surges and bushfires (with CS)
- how a changing climate and emissions reduction measures will impact sources of air pollution and secondary pollutant formation (with CS)
- the effect of hazardous wastes on the health, cultural, social and economic well-being of Indigenous communities (with RL)

From these discussions, several key collaborations with other hubs have commenced, consistent with RP 2022. These include:

- IP1.02.02 *Nature Connection* has sought to connect with the Resilient Landscapes Hub and the Marine and Coastal to explore common interests in working with the Tasmanian Aboriginal community to understand the connections between Indigenous land management practices (on land and in the water) and the wellbeing of these communities. These conversations are continuing into 2023 with an intention to develop a formal, cross-Hub, Indigenous-led project.
- IP1.02.01 *Water Sensitive and Liveable Communities* has continued conversations throughout 2022 with the Climate Systems Hub in the development of a research agenda that can support the Climate Adaption Initiative through supporting an improved evidence-base for adaptive decision-making for climate resilience.
- IP2.02.01 *Understanding Microplastics* held initial conversations with the Marine and Coastal, and Resilient Landscapes Hubs regarding linkages between the hubs on developing a risk framework for microplastics on threatened, endangered and protected species listed in the EPBC Act. This work is being progressed in 2023, working towards hosting a cross-hub workshop to develop the risk framework.
- IP3 exploration of the assessment and monitoring of nutrients, chemicals, and antimicrobials relevant to the NESP Marine and Coastal Hub has not been explored yet. Rather than expand efforts in 2022, it was deemed that a focus on the SCAW Hub priorities in IP3 were critical given the short period of RP2 and the scale of resources available to establish important analytical approaches and obtain initial waste chemical data.
- IP4 continued engagement with the climate adaptation cross-cutting program of the Climate Systems Hub for project *IP4.02.02 'How will a changing climate and emissions reduction measures impact sources of air pollution and secondary pollutant formation?'.* This project includes a scoping study to gather existing knowledge from the international literature and engage with national and state environmental policymakers to ascertain what potential emission reduction actions are likely to be undertaken by Australia. The project leverages modelling capabilities of the IP4 team to progress this work as well as modelling capability in the Climate Systems Hub and will contribute to cross-hub activities, with the expectation that effort will be supported by the Climate Systems Hub for this work in future years.

The Waste Impact Management Initiative also focused in 2022 on building research and impact linkages within the SCAW Hub and working with the Knowledge Broker and Data Wrangler to create the underpinning knowledge platform. This included identifying linkages between technical and socio-economic areas of SCAW Hub research and synergies and trade-offs along material to waste supply chains. Internal SCAW Hub cross collaboration progressed this year, with a focus on ensuring synergies and alignment between IP areas, including for:

- tyres and end-of-life (EOL) tyres - research across IP2, IP3 and IP5 worked together to better consolidate the Hub's research impact in the management of tyres. An initial workshop was held between IP2, IP3 and IP5 to ensure that research priorities aligned and that there was no duplication of effort. It is clear from initial engagement of the need for a SCAW Hub-wide research position on EOL tyres management which is being developed. There is an opportunity to broadly communicate the outcomes and deliverables of each of the IP2, IP3 and IP5 research activities in a consolidated manner.
- working with regional and remote communities:
 - to ensure synergies and alignment, several discussions were held between IP2 and IP5. A key decision from these discussions was to develop a single survey instrument for regional and remote local governments across Australia which will be rolled out in 2023.

- discussions were held between IP1 and IP5 to ensure synergies and identify future collaborative opportunities focussed on place-based capacity building of Local Government practitioners and cross-hub networking and alignment for Indigenous-led initiatives. Both aspects were in planning during 2022 and will commence in 2023.

The work of the Initiative Lead was supported by the evolving governance and agreed operating principles of the SCaW Hub that foster collaborative networks within the Hub and horizontal integration of research topics. The integration of the Initiative lead and the waste impact management research agenda is a key role of the Hub leadership team. As partnerships within the SCaW Hub further mature, the impact of the Initiative Lead role will continue to grow.

Emerging priorities

The 2022 October Budget committed the Australian Government (Treasury) to produce a “Measuring What Matters Statement” in 2023. The Statement will *“lay out the government’s proposed wellbeing measures...expected to draw on international frameworks established over the past half-century.”*

The Department requested SCaW Hub, through an emerging priority project to undertake a 2 month scoping study into ‘Environmental Indicators for Wellbeing and Productivity’. This scoping study is being used by the Department and Treasury to inform the development of a framework of environmental indicators linked to the wellbeing and productivity of Australians.

The research team compiled and assessed 34 wellbeing indices from around the world, as well as proposed themes and indicators from the Department. The original intention was to narrow down this collated list of environmental indicators and provide the Department with a well justified shortlist of candidate indicators suitable for measuring what matters for the wellbeing and productivity of Australians.

As a result of a literature review to understand the linkages between wellbeing and the environment and a key outcome that these linkages are not well defined or understood, it became clear that the framework linking the environment and wellbeing was critical for defining ‘wellbeing’ and therefore which indicators were appropriate for measuring it. The team then redirected efforts towards developing a conceptual framework to provide a robust theoretical underpinning for Australia’s indicator selection. It is our view that both the framework and potential indicators require co-design by diverse Australians.

Therefore, rather than recommending a set of discrete measures and data sources for wellbeing indicators in Australia, the report presented a potential sustainable wellbeing framework and possible categories of environmental indicators that should be captured. To further assist with the process of indicator selection, a comprehensive set of guiding principles and selection criteria were also developed. A key recommendation was that additional research be conducted to develop indicators and that a detailed consultation process seek out the voices of diverse Australians, particularly Indigenous Australians.

Performance against milestones

Performance against funding agreement milestones

All milestones for the reporting period and to date have been met as per the funding agreement (Milestones 1 to 12).

Performance against the research plan milestones

Information on project progress and performance is provided in Attachment A.

Measuring success

Hub outcomes and outputs

With the Hub in its second year, the focus was on mobilising teams, commencing research, and continuing the collaboration with project partners and research-users. Outputs were delivered in line with the Research Plan for 2022. Outcomes for 2022 focused on delivering best-practice research as we move forward along the impact pathway. As the research progresses over the next few years, the outcomes will become more evident to demonstrate the impact delivered by the Hub to governments, industry, and communities, including Indigenous.

IP1 – Sustainable people–environment interactions (led by UTAS and MU)

IP1 project work focussed early in 2022 on developing nature connection and urban greening research plans through workshops and codesign meetings before ramping up major research project efforts in the second half of the year. Through co-design, engagement was undertaken with people from a broad range of sections within the Department including Heritage Reef and Ocean, Trade Market Access and International, International Strategy and Engagement, Commonwealth Environmental Water Office, Parks Australia - Booderee and Business Services, Biodiversity Science and Knowledge Management, Climate Adaptation and Resilience, Parks Australia - Australian Marine Parks, Climate Adaptation and Resilience Division - Blue Carbon and International Partnerships, Water Division - Basins Policy, Indigenous Water Policy, and Biodiversity Conservation Division.

Several meetings and workshops were held throughout 2022:

- Meeting at CSIRO Black Mountain in May 2022 with 21 individuals including Department representatives as well as a representative from the Department of Infrastructure, Cities Division.*
- Three online co-design meetings in July 2022 with the Department, covering Indigenous engagement, Nature-based solutions, and nature-connection and urban greening involving 18, 20, and 14 individuals, respectively.*
- The Nature Connection Workshop Spring Bay Mill, also in July, with 23 individuals from a diverse range of organisations, including Indigenous and not-for-profit organisations, educational institutions, industry partners, local governments and members from other NESP Hubs. Through this workshop we developed a roadmap and report for the nature connection project.*
- Online co-design meeting with 36 participants including Department staff and representatives from Indigenous and not-for-profit organisations, educational institutions, industry partners, local governments and members from other NESP Hubs. Department of Biodiversity, Conservation and Attractions (WA); City of Launceston; Kingborough Council; Southern Waste Solutions; Department of Environment & Science (Qld); Tamar Estuary and Esk Rivers Program; Royal Botanic Gardens, Victoria; City of Melbourne; Brighton City Council; Knox City*

Council; Department of Environment, Land, Water and Planning (Vic); Landcare Tasmania; TierraMar; Conservation Volunteers Australia; and NESP Resilient Landscapes Hub.

- *Nature Connection Storytelling Project Workshop at Royal Botanical Gardens, Hobart in December with 25 participants from not-for-profit organisations, educational institutions, industry partners, and local governments.*

These co-design workshops provided the IP1 team with a better understanding of how to capture people's connection to nature in Australia. There was a shared sense that connection to nature is important to improving health and well-being, encourages pro-environmental attitudes and behaviours, and can inform organisation decision making. A common theme was the need to have a diverse range of voices including Indigenous communities, people working in the health sector, disadvantaged groups most likely disconnected from nature, and people engaged with nature but not engaged in what we might consider pro-environmental behaviours.

Several reports were produced to share the outcomes of these workshops that are or will be publicly available on the SCaW website.

Progress was also made with research efforts in the nature connection space, especially securing co-funding for the national survey and developing substantial new partnerships and engagement with the storytelling project. Several research-user priority projects were delivered during the year on the value of dark skies, and the status of nature-based solutions in Australia. Knowledge products for all of these will be released in 2023.

IP1 responded to an emerging priority in late 2022 to develop a set of environmental indicators to feed into the indicators the Treasury are developing under the heading of "Measuring what matters for progress and wellbeing". This set of environmental indicators should effectively monitor the state of the environment as well as its impact on human wellbeing and productivity through provisioning of essential ecosystem services. Knowledge products from this work will be released in 2023.

The Nature Connection team co-designed a national survey on the benefits of nature connection, and nature-connection storytelling website. Ethics applications for these projects are underway and data collection is expected to occur in 2023.

IP1.2 Water Sensitive and Liveable Communities

In this project, the focus this year was on initial scoping and early implementation across two interlinked streams of research:

Stream 1: improving access to fit for purpose knowledge capital and products for regional and remote communities.

Stream 2: providing evidence-based frameworks and models to structurally empower Indigenous voices and participation in decisions that impact on their rights of self-determination and on exercising their stewardship of Country.

Notably these two streams are intended to be integrated in future years through place-based research that will draw upon foundational knowledge and progress made in establishing contextually and culturally sensitive (indigenous led) pathways to water sensitive and liveable communities in regional and remote Australian communities.

Stream 1 during 2022 undertook a comprehensive review of existing tools and products in relation to urban water and liveability-based planning and management. The purpose of this review was to provide a summary of the current state of play for Water Sensitive Cities (WSC) knowledge and practice in Australia and an exploration of what needs to be done to evolve and scale out WSC knowledge and practice to regional and remote communities across Australia.

A report was produced that synthesises insights generated from a literature review and a series of semi-structured interviews. Findings highlighted the extensive progress in knowledge generation, tools and products to date. Findings also pointed to several critical knowledge gaps and future capability

needs for further exploration to understand key requirements for scaled remote and regional uptake. The report is currently being finalised and will be published in 2023.

These findings are being used to inform the development of a national qualitative user survey in 2023 that will provide understanding of the existing needs, aspirations and priorities of urban planning and local government practitioners and agencies in respect to their water and liveability-based planning practices. Specifically, the survey will generate insight on the functionality, evidence requirements, use cases and any barriers/constraints, such as limited capacity and/or resources, for consideration in the design of a context sensitive platform. An ethics application is underway for approval in the first quarter of 2023. A report on survey findings is anticipated to be available in May 2023.

The outcomes from the survey will provide the foundations for a series of subsequent co-design workshops (commencing second half of 2023). These workshops will seek to establish a research-user centred approach and platform aimed at enhancing uptake and supporting capabilities for water sensitive cities and liveability-based knowledge and product application in remote and regional local government areas.

Stream 2 is exploring pathways for harnessing Indigenous knowledge and empowerment for water and land planning and is in early planning to convene in 2023:

- a three workshop series, aiming to bring together Indigenous scholars and water practitioners to explore: aqua nullius (workshop 1), Indigenous water science practices and governance (workshop 2), and strategies to negotiate the use of Indigenous science methods and water governance (workshop 3)
- a colloquium shaped by the outcomes from the workshops and aimed at creating the conditions for an Indigenous-led review of the work required to transform the architecture of the Australian water sector, including legislation and institutions, to allow the re-enfranchisement of Indigenous water science and governance.

To date, Indigenous water scholars at Monash University has been overseeing the initial planning of these initiatives and have sought to build key relationship with Indigenous water knowledge holders (academic, practice-based and otherwise) for broad participation in these workshops.

It is anticipated that the outputs of the workshops and colloquium will guide a series of place based participatory action research outcomes and case studies (2024-2026), exploring Indigenous led governance and institutional frameworks and models for Indigenous water outcomes.

IP2 - Reduced impact of plastics and other materials (led by UNSW and Curtin)

IP2 has delivered several outputs during 2022, as well as some preliminary outcomes:

IP2.02.01 Understanding Microplastics

A core outcome in 2022 was the identification and understanding of the severity of microplastic waste for Australia's ecosystems and the risks associated with the widespread contamination of microplastics, particularly in our aquatic systems.

This outcome was a result of co-design workshops in 2022 that involved the Department, state and local governments, and other stakeholders. A key focus area of minimising the impacts of microplastics was identified. Microplastic identification and minimisation is being formalised in 2023 and includes a multi-year project to better understand microplastics.

This year several key stakeholders within the community were engaged, including organisations that assess Australian microplastics in aquatic environments and document and analyse the pollution.

These interactions will be formalised in 2023 to build upon the work each organisation is undertaking and to encourage collaboration towards a unified goal.

A report was delivered on microplastics. It outlines the findings from a literature review of current best practices for detecting and quantifying micro and nano plastics, identifying the environmental matrices that require deeper investigation in 2023 and the identification of microplastic sources and sinks.

A comprehensive list on plastic additives was also produced to identify which national and international watchlists a particular chemical could be found in. This list fills an important gap for recyclers and manufacturers who may struggle to correctly identify potential hazards associated with the plastic additives that can be found either in the waste that is being processed/analysed or with the additives being used in the products they are manufacturing.

IP2.02.02: Finding fit for purpose technological recycling solutions for regional and remote communities across Australia

IP2, during 2022 worked with the Department to understand the requirements for finding fit-for-purpose solutions for regional and remote communities.

One of the outcomes during 2022 has been the establishment of a working relationship with the City of Bunbury in Western Australia and other communities to reduce plastic waste and promote sustainability. This has included transferring learnings from innovative solutions for recycling and remanufacturing plastics from councils, such as Shoalhaven City Council in NSW, and monitoring progress through tracking the reduction of plastic waste and its impact on the environment and economy. The City of Bunbury wants to be a hub for plastic waste reduction and a leader in sustainability in the region, resulting in a cleaner, healthier and more sustainable environment for the people in southwest Western Australia and beyond.

IP2.02.03: Plastic-reinforced artificial reef structures; improving understanding.

During 2022, a review of scientific literature and interviews with experts was conducted into the environmental implications of the use of plastic reinforced concrete (PRC) for artificial reefs to inform the permit application process for purpose-built artificial reef structures. A key outcome coming from this work will be improved knowledge for the Department in finalising the draft policy relating to use of plastic in artificial reef structures.

IP3 - Management of hazardous waste, substances and pollutants (led by CSIRO and Monash)

Using end-of-life (EOL) tyres and e-wastes as our initial target waste streams (case studies), key outputs for 2022 delivered against the objectives of the project were:

1. To develop a robust sampling design and strategy for sampling Australian tyre and e-waste streams

A robust sampling strategy for EOL tyres and e-waste is critical to ensure confidence in risk and hazard assessments related to the safe reuse of wastes and recovered resources. For example, the volume/mass of subsamples recovered, frequency of subsampling, and considerations of strategies for sampling from waste piles can impact the quality and reliability of analytical data generated. Non representative samples may provide inaccurate information regarding thresholds or trigger limits and

skew risk assessments for identified chemicals, or even fail to identify risks associated with chemicals.

During 2022, the IP3 research team and the Department co-designed a preliminary and transferrable guidance document using EOL tyres as a case study that outlines the iterative principles of sampling plan design for complex waste materials.

2. To build current and relevant quantitative analytical datasets for the composition, detectable limits, and concentrations of chemicals in Australian tyre and e-waste streams

To determine 'what's in our waste' and define hazards related to the chemicals which they may contain, reliable characterisation of EOL tyres and e-wastes and recovered waste-derived materials is required.

In 2022, concurrent modification and development of analytical methods to best determine the chemical composition of these wastes were conducted using analytical capability at CSIRO and Curtin University and associated commercial laboratories. Preliminary qualitative and quantitative characterisation of chemicals associated with a commercially available recycled rubber product and e-wastes was also undertaken. A data reporting tool was developed by the Department for the data generated in this project to be reported in an accessible format.

3. To develop a methodology to assess leachability and potential availability of chemicals from tyre and e-wastes and associated re-purposed materials

In 2022, a draft methodology for assessing the leachable components in EOL tyres and recycled rubber products was developed by the IP3 research team, with input and feedback from the Department. The document outlines the preliminary experimental plan for assessment of leachable chemicals in recycled rubber products and e-waste materials using standard and non-standard leaching and will allow further characterisation of these materials and foundation data for the development of ecotoxicology assessments in forward years of IP3 research.

IP4 Air quality, forecasting and assessment (led by UTAS and CSIRO)

All four IP4 projects have been designed with input from stakeholders, the Department and collaborators. IP4.02.01 did not have any outputs for 2022 but will progress into 2023 with an Indigenous led event in collaboration with other partners looking at Indigenous health and smoke impacts.

Planned outputs for IP4.02.03 and IP4.02.04 including factsheets for public/government/agencies to support selection of interventions to reduce exposure to poor air quality commenced development and are due for publication in 2023. Data will be made available for policymakers to use in the development of guidance documents.

Work commenced in IP4.02.02 on the modelling of a range of potential climate change reduction scenarios to evaluate the impacts on air quality. These outputs will support decision making around the most effective approaches to apply.

IP5 - Waste impact management initiative (led by CSIRO and MU)

Project IP5.02.01: Australian metrics for materials, waste and resource recovery summarised in a circularity gap report and dataset

Key outputs delivered for 2022 were as follows:

- An Australian economic input-output table with detail for economic sectors and for all states and territories was sourced from the Australian Virtual Industrial Ecology Lab (IE Lab).

- The newest edition of the GLORIA global, multi-regional input-output table representing 120 economic sectors and all countries of the world was sourced from the literature.
- The detailed Australian I-O table was integrated into the GLORIA global table (resulting in a nested structure) and the table rebalanced to represent the global supply chains between industries.
- A domestic extraction satellite for all countries in the World was sourced from the International Resource Panel online database and the Australian extraction data downscaled to states and territories.
- A test run was undertaken to establish the material footprint accounts and to enable the analysis of material flows through the economic system from cradle to grave.

The circularity report will provide a dataset for material use, waste and emissions and presents indicators for reuse, recycling, and circularity. The high-level of data granularity will assist in addressing the policy needs of the Department and other stakeholders. Its' scope will be broad, covering the whole spectre of circular economy opportunities that exist across material supply chains and look at direct and embodied flows (i.e., footprints) to assess volumes managed in Australia and within Australia's international supply chains.

The knowledge base generated is a starting point for an Australian data architecture and information system for material and waste flows based on and enhanced by digital capabilities and industry and community participation. The Australian material flow, waste and circularity data will also contribute to Australia's State of Environment reporting and to international reporting initiatives.

Project IP5.02.02: Exploring opportunities for increasing value recovery from used tyres and conveyor belts in Western Australia

The key output from this project was a report that is currently being reviewed by the Department and will be published in 2023: Boxall NJ, Tobin S, Minunno R, Cheng KY, Zaman A, Kaksonen AH. (2023) Exploring opportunities for increasing value recovery from end-of-life tyres and conveyor belts in Western Australia. CSIRO, Australia.

The interdisciplinary science approach taken in this study is expected to provide better information to inform decisions to overcome market barriers, to enable the reduction of stockpiling, dumping, landfilling and onsite disposal of used tyres and conveyor belts, and to facilitate value recovery from these wastes in WA, leading to economic benefit and reduced human and environmental risks. This will allow for science-based decision making for managing tyre and conveyor belt material flows, developing recycling capacity, creating market potential and establishing regulatory and policy instruments in WA to help overcome market barriers and to enable diversion of waste from stockpiling, dumping, on-site disposal and landfilling to value recovery from used tyres and conveyor belts, especially in regional areas. The insights gained from the WA based case study will inform industry, state and national strategies to improve the circular economy of tyres and conveyor belts and will also be relevant to regions with similar economic characteristics.

Project IP5.02.03: Governing community-based resource recovery and circular economy initiatives
Work undertaken in 2022, including a literature review, desktop review and situation reports, is being captured in a peer reviewed publication to be submitted to the journal, Local Environment, in 2023.

Key outcomes in the short term from this work will be a prototype networked governance model to support community-led Circular Economy (CE) and resource recovery activities in regional and remote Australia and to establish relationships with key partners for information sharing.

Project IP5.02.04: Scoping study creating opportunity from waste in Aboriginal communities in Western Australia

Key outputs from this project during 2022 included the identification of Aboriginal communities wanting to participate, the development of the Aboriginal Terms of Reference (ATR) framework (in progress), building trust through engagement and co-design within the Aboriginal communities to address waste problems and commencement of activities to understand key waste management issues in these communities.

The study will identify representative Aboriginal community groups and build trust through an effective engagement and co-design process founded on the ATR framework. This will be achieved by engaging and involving Aboriginal communities and listening to the issues and understanding the possible solutions and opportunities by integrating innovative technology, upskilling, creating jobs and business opportunities within the communities.

Project IP5.02.05:

This project provides the operating budget for the Waste Impact Management Initiative Lead to engage in cross-hub collaborations with the other NESP hubs. To date, all meetings were online, so the funds are yet to be expended. Outcomes from 2022 are discussed in the Cross-hub Initiative section of the report.

Short- to medium-term outcomes – quantitative measures

Table A: Quantitative performance measures (short- to medium-term outcomes)

Notes: Reporting period means the calendar year preceding the Annual Progress Report. For the second year of NESP 2 hubs, the reporting period is January to December 2022. Unless specified otherwise, the term 'research-user' refers to departmental and/or external users. The data below will ideally provide numbers derived from routine Hub monitoring and reporting. Where an estimate is provided, please explain how it was determined.

No.	Performance measure	Result for reporting period (Numerical only)	Explanation, if any
1	Proportion of projects (active or completed in the reporting period) for which there is a research-user actively engaged in the project: a) co-design b) research delivery c) use and research uptake	<p>Total number of projects/Number of these that meet the KPI</p> <p>a) Hub 16/16</p> <p>IP1- 2/2</p> <p>IP2- 3/3</p> <p>IP3- 1/1</p> <p>IP4- 2/2</p> <p>IP5- 8/8</p> <p>b) Hub 9/9</p> <p>IP1- 2/2</p> <p>IP2- 3/3</p> <p>IP3- 1/1</p> <p>IP4- 1/1</p> <p>IP5- 2/2</p> <p>c) Hub 6/8</p>	<p>IP1 – During this reporting period IP1's focus was on workshops and co-design meetings to develop and ramp up the major research projects to begin data collection.</p> <p>IP2 – RP 2021 to mid-2022 had 4 projects</p> <p>RP mid-2022 to December had 3 projects</p> <p>IP3 – IP3 has one project and DCCEEW as primary research-user are involved in all aspects, with approximately monthly reporting and progress meeting.</p> <p>IP4 – IP4.02.01 – co-design of Key Thinker's forum with HEAL Network and Macquarie University.</p> <p>IP4.02.03 – hosted a workshop with support from NZ councils, state-level EPA and health departments as well as university researchers. IP4.02.03 – will collaborate with local government to evaluate different interventions.</p> <p>IP5 - IP5.02.01: coordinated research focus with DCCEEW waste policy implementation teams and newly formed circular economy team; engagement with State governments in the context of the ACE Hub metrics working group; engagement with DISR recycling and clean energy team. Development of principles for circular economy metrics.</p>

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No.	Performance measure	Result for reporting period (Numerical only)	Explanation, if any
		IP1- 0/2 IP2- 3/3 IP3- 1/1 IP4- 1/1 IP5- 1/1	<p>IP5.02.02.02: research focus co-designed with Western Australian (WA) Department of Water and Environmental Regulation (DWER) Waste Authority, Tyre Stewardship Australia (TSA), and coordinated with DCCEEW. Research report delivered to local partners in WA and acknowledgment of recommendations by the research-users and building a foundation for further research activity.</p> <p>IP5.02.03: Research co-design with two local communities in Victoria (Ballarat and Bendigo) and one in Tasmania (Launceston).</p> <p>IP5.02.04: Identification of aboriginal communities and business in the Swan-Canning Catchment is underway to co-develop research focus.</p> <p>IP5.02.05: Coordination meetings with the leadership of the Resilient Landscapes Hub leadership</p>
2	Research outputs in the reporting period provided to research-users on time and as identified in the approved research plans: d) total number e) proportion	Total Number d) Hub - 23 IP1- 5 IP2- 6 IP3- 9 IP4- 1 IP5- 2 Total number of projects/Number of these that meet the KPI e) Hub 13/15	<p>IP1 – During this reporting period IP1’s focus was on co-design of specific Nature Connection projects. The primary outputs were reports on workshops and codesign meetings and a fact sheet.</p> <p>IP2 – Two reports have been delayed and will be delivered in Q1 of 2023.</p> <p>IP3 – All milestones were delivered within the RP2022 timeframe.</p> <p>IP4 – All four projects delivered the RP2023 proposal which was the only deliverable for 2022.</p> <p>IP5 - IP5.02.01: Developed datasets and analytical tools and published principles for CE metrics; IP5.02.02.02 delivered a significant research report on tyre and conveyor belt recycling and circular economy in WA</p>

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No.	Performance measure	Result for reporting period (Numerical only)	Explanation, if any
		IP1- 5/5 IP2- 4/6 IP3- 1/1 IP4- 1/1 IP5- 2/2	
3	Proportion of completed research projects that are confirmed to meet the needs of departmental research-users as identified at project co-design stage	Percentage meeting needs of research-users as identified at co-design stage IP1 – 100% IP2 – 100% IP3 – 100% IP4 – 100% IP5 – 100%	<p>IP1 – All projects are ongoing.</p> <p>IP2 – The Artificial Reefs report was accepted by the Department.</p> <p>IP3 – DCCEEW has provided guidance and feedback on a regular basis – so IP3 outputs meet departmental needs.</p> <p>IP4 – All projects are ongoing.</p> <p>IP5 – A report for the Western Australian government and the tyres federation proposing approaches for fostering a circular economy of tyres and conveyor belts has been provided to the research-users who co-financed the project. The project team is now discussing next steps in the research.</p>
4	Number of projects that: a) are Indigenous-led b) meet research and management priorities of Indigenous stakeholders c) are Indigenous-led projects that also meet research and management priorities of Indigenous stakeholders.	a) Hub - 0 IP1- 0 IP2- 0 IP3- 0 IP4- 0 IP5- 0	<p>IP1 – is still in the process of developing Indigenous-led projects. However, both of our projects are being developed in consultation with Indigenous partners to meet their research and management priorities.</p> <p>IP2 - IP2 is working with Indigenous stakeholders for IP2.02.01 Understanding Microplastics, and IP2.02.02 Regional and Remote Communities to have Indigenous led subprojects.</p>

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No.	Performance measure	Result for reporting period (Numerical only)	Explanation, if any
		b) Hub 5 IP1- 2 IP2- 2 IP3- Only indirectly IP4- 0 IP5- 1 c) Hub 0 IP1- 0 IP2- 0 IP3- 0 IP4- 0 IP5- 0	IP4 - Project 1 is not yet being led by Indigenous personnel. We hope to identify someone through Curtin University for 2023 to lead the work. IP5: IP5.02.04 and IP5.02.05 have a focus on Indigenous communities and businesses.
5	Number of peer-reviewed, NESP-funded publications during the reporting period	0	Several publications are in development and will be published in 2023.
6	Number of NESP research citations in other researchers' publications during the reporting period	0	There have been no citations to date for any IP. There are several workshop reports from IPs which may generate some citations in the future.
7	Number of completed NESP products, research publications, datasets and metadata that are discoverable and accessible in accordance with <i>NESP data and information guidelines</i> and the funding agreement	3	IP1 – All products produced in 2022 are being made publicly available in accordance with the Hub policies in 2023. Fact sheets were produced this year. IP2 - All products produced in 2022 are being made publicly available in accordance with the Hub policies in 2023.

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No.	Performance measure	Result for reporting period (Numerical only)	Explanation, if any
			<p>IP3 – There are several non-public documents (e.g., sampling guidance, leaching plan, chemical reports) and growing datasets which are yet to be formalised and made public.</p> <p>IP4 – All products produced in 2022 are being made publicly available in accordance with the Hub policies in 2023.</p> <p>IP5 – Two products - report on tyre and conveyor belt recycling for WA and the principles for circular economy metrics piece Principles for Circular Economy Metrics.pdf (ctfassets.net)</p>
8	<p>a) The number of datasets and management tools produced by Hub research and made public.</p> <p>b) The number of other datasets and management tools that benefitted from hub research and outcomes.</p> <p>Management tools include but are not limited to monitoring systems; web-based decision support systems; environmental management tools for Indigenous communities, waters and land management; plans of management for Indigenous Protected Areas (IPAs), co/jointly managed parks, marine park plans of management, conservation agreements.</p>	0	<p>During 2021 and 2022, the Hub was directed to co-design new research plans and identify stakeholders. In 2023 and beyond, the Hub will begin producing data and outputs that will fulfill KPIs. In some instances, the data gathering phase of the projects is over and given most projects are multiyear projects, it will push the publication of data products to later stages of the project. However, the data wrangler is working with all the IP leaders to ensure that the data becomes accessible as early as possible in the research process.</p> <p>IP1 – is still focussed on developing such datasets and tools for public release throughout the life of the Hub.</p> <p>IP2 - is still focussed on developing such datasets and tools for public release throughout the life of the Hub.</p> <p>IP3 – No datasets have been made public. The datasets are growing. Note that some data may never be made public since it may be commercial in confidence, may lack contextual metadata or may be overly preliminary. Most data will eventually be</p>

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No.	Performance measure	Result for reporting period (Numerical only)	Explanation, if any
			<p>available publicly – and largely via DCCEEW. The data have been invaluable in framing future data needs and R&D directions of importance nationally.</p> <p>IP4 - is still focussed on developing such datasets and tools for public release throughout the life of the Hub.</p> <p>IP5 – Datasets on material extraction and waste at State level have been compiled and MRIO analytical tool has been established for future analysis of waste and recycling in the context of Australia's material flows.</p>
9	<p>Number (full-time equivalents) during the reporting period of:</p> <ol style="list-style-type: none"> 1) PhD students 2) post-doc and early-career researchers 3) mid-career researchers 4) Indigenous researchers 5) individual volunteers (total) 6) individual Indigenous volunteers (total) 7) Indigenous sub-contractors 	<p>Hub – 27.44 FTE</p> <p>2</p> <p>10</p> <p>6</p> <p>1.5</p> <p>6.44</p> <p>0</p> <p>2</p>	
10	<p>Number of knowledge-sharing and communication events and activities held or shared:</p> <ul style="list-style-type: none"> • with on-ground managers (general) • jointly with Indigenous researchers and Traditional Custodians • that are Indigenous-led 	<p>Hub - 26</p> <p>a) 23</p> <p>b) 3</p> <p>c) 0</p>	<p>On-ground managers are defined as working in a place where practical work is done to manage Country or an environmental or climate change issue; that is, where things are happening on-ground (not at a distance or in theoretical manner).</p> <p>IP1 – Meetings with waste suppliers, DEWLP, Victoria EPA, TSA – to frame involvement and partnerships</p> <p>IP5 – Four presentations at Australian Circular Economy events (conferences and symposia);</p>

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No.	Performance measure	Result for reporting period (Numerical only)	Explanation, if any
			presentation at the Regional 3R and Circular Economy Forum for Asia and the Pacific in Cambodia; contribution to UNEP Global Environmental Outlook 7.
11	Proportion of hub staff and researchers who have completed: <ul style="list-style-type: none"> a) Indigenous cultural capability training b) Indigenous cultural and intellectual property training c) both Indigenous cultural capability training and Indigenous cultural and intellectual property training 	<ul style="list-style-type: none"> a) 100% b) 5% c) 5% 	All hub members have undertaken cultural capability training through YourMob. Any additional training such as ICIP training is at the discretion of IP leads. All IPs are informed when training is offered each year.
12	Proportion of hub projects overall that fall within the categories of the Three-category approach: <ul style="list-style-type: none"> 8) Category 1 - Communicate 9) Category 2 - Collaborate 10) Category 3 – Co-design 	<ul style="list-style-type: none"> Hub - 12 IP1- 2 IP2- 3 IP3- 1 IP4- 4 IP5 - 2 	<p>IP1 - Direct engagement with Indigenous partners and communities began for IP1 in 2022 but the work to develop formal projects is expected for 2023 and 2024. Both IP1.02.01 and IP1.02.02 have a comprehensive plan to develop indigenous-led research for RP3 and future years. Both projects for IP1 are in category 2.</p> <p>IP2 – IP2.02.01 and IP2.02.02 are both currently developing Indigenous partnerships and in Category 2.</p> <p>IP3 – Direct engagement with Indigenous partners and communities was not planned for 2022. We have continued to engage with the Hub related to opportunities for relevant Indigenous engagement through forward years.</p> <p>IP4 - IP4.02 projects are all currently sitting within the Category 1.</p> <p>IP5 – Engagement with indigenous communities and businesses in two projects as Category 2.</p>
13	Proportion of hub projects that have been developed in consultation with the hub Indigenous facilitator or the Indigenous Facilitation Network	3	Projects are in IP1, IP4 and IP5.

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No.	Performance measure	Result for reporting period (Numerical only)	Explanation, if any
14	<p>Number of guidelines about best-practice that the hub has produced or co-produced in the reporting period, for:</p> <ul style="list-style-type: none"> a) knowledge brokering (e.g. https://www.nespthreatenedspecies.edu.au/publications-and-tools/connecting-research-with-policy-guide-to-writing-for-policy-makers) b) Indigenous partnerships and products (including design of flagship engagement activities e.g. <i>Our Knowledge Our Way</i>; <i>Three Category Approach</i>) c) environment and climate management within the scope of the hub's research (e.g. <i>Guidelines for the translocation of threatened plants in Australia, Third Edition</i>; https://www.nespmarine.edu.au/project/project-d2-standard-operating-procedures-survey-design-condition-assessment-and-trend) 	3	<p>IP1- To date IP1 has produced no best-practice guidelines. These are scheduled for subsequent research phases for IP1 projects 01 and 02.</p> <p>IP3 – Draft waste sampling guidance with a focus on end-of-life tyres, has been produced, but it is not yet fully reviewed so not publicly available at this time.</p> <p>IP4 – To date IP4 has produced no best-practice guidelines.</p> <p>IP5 – Principles for circular economy metrics report has been developed but not published.</p>

Longer-term outcomes – qualitative measures

This is the second year of operation for the Hub and the first year where research started to be implemented. Therefore, longer-term outcomes are yet to be realised. The Hub is on an impact pathway that will progress as the research matures over the life of the Hub, towards medium to longer term outcomes for our key stakeholders, namely governments, industry, community, including Indigenous communities. Many outcomes are expected though and summarised below.

IP1 have developed and delivered on several co-funded, partner-led projects exploring eco-restoration and wellbeing, equitable urban greening and research-user-driven projects on nature-based solutions and the values of dark skies. As partner-led projects, these are already informing and impacting policy and practice. The equitable urban greening report led by UTAS has been developed in collaboration with the City of Launceston to inform their urban greening activities and policy. The eco-restoration and wellbeing report and publication have received interest from restoration practitioners across Australia through the EcoHealth Network. Efforts in working with Tasmanian Aboriginal Communities resulted in cross-Hub participation in a Cultural Awareness and Sensitivity training session in early 2023.

The collaborative initiatives undertaken throughout 2022 have established meaningful cross-sectoral relationships with key stakeholders across government (local, state and federal), non-governmental organisations, Traditional Owners and the community. These workshops support the co-design of projects, outputs and outcomes and contribute to the long-term delivery of these transdisciplinary research programs. They also effectively support industry-researcher co-learning, knowledge translation and adoption and are critical to the success of IP1 and the development of fit-for purpose tools, reports and outputs to support meaningful sustainability and self-determination outcomes relating to people and environmental interactions.

For IP1.02.01, workshops have clarified partner and research-user needs for the national survey (and therefore survey design) and the storytelling project (and therefore the design of the web-platform for story collection and sharing) and strengthened partnerships. For IP1.02.02, recent and future workshops will support a collaborative agenda between regional and remote local government associations and statutory authorities, alongside Traditional Owner led tools and practices to support a collaborative planning agenda for water sensitive and liveability outcomes relating to healthy people, Country and culture.

The **emerging priority** addressed during 2022 involved a scoping study for the Department on environmental indicators that could feed into the *Measuring what Matters* process being run by Treasury. Though this was a discrete, and short-term project, work is continuing to build on it towards longer term outcomes through working with research-users for approval to develop public-facing knowledge products from the internal report. The project team is also continuing to engage collaboratively with the *Measuring what Matters* process outside of the NESP process as part of the formal stage two consultation phase. Engagement is also ongoing with research-users to explore possibilities for further contributions to this important process.

IP2 established a good foundation for delivering different outcomes and useful knowledge around microplastics which is unique and had not been undertaken before. Microplastic has not been fully studied from a materials perspective and understanding it will help those trying to manage it to identify techniques which can enable prevention of microplastics. The research will also help in identifying approaches for dealing with microplastics that have already been collected by stakeholders using different filtration processes.

Several case studies are being established of relevance to regional and remote communities across Australia, including in southwest Western Australia and the Shoalhaven region in New South Wales.

They will demonstrate how different technologies can assist in addressing hard to recycle waste streams in local areas. Through this project, it is expected that the solutions identified will assist regional and remote centres in finding solutions and promoting sustainability for the future.

IP3 will build on the strong research foundation generated in 2021 and 2022 to continue to provide data and methodologies for the characterisation of risks associated with identified chemicals in EOL tyres and e-waste. Research in 2023 has three focus areas:

- To validate sampling and analytical strategies by intensifying analysis of targeted e-waste and EOL tyre components focused on quantification of chemical concentrations and mass in wastes.
- To establish the leachable chemical fractions from the waste streams and/or repurposed materials to inform risk assessments and handling.
- To establish methodologies for ecotoxicological studies that may be warranted based on leachable chemicals from e-waste and EOL tyre components.

The time horizon foreseen to address hazardous waste challenges related to IP3 is shown in Figure 5 and provides the planned vision and the foundation work of RP2021/RP2022 and how it feeds into the research needed and scoped in RP2023-2024, and ultimately RP2025 (subject to success in early years).

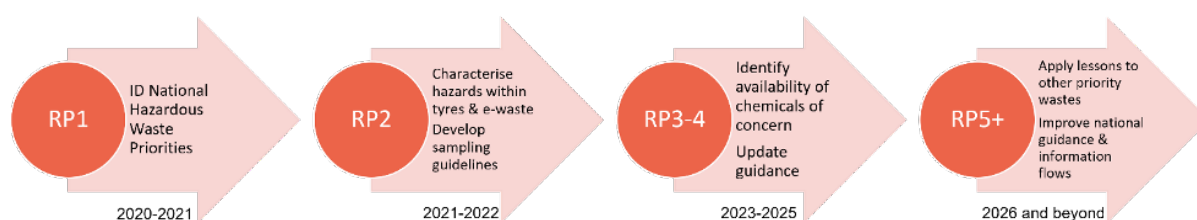


Figure 5 Time horizon for Impact Priority 3 (Hazardous Waste, Substances and Pollutants)

IP4 outcomes will be realised as the program of work progresses through 2022 into future years. IP4 research outcomes will ultimately result in reduced exposures to poor air quality. By co-designing this research there will be greater participation in air quality research and uptake of research outcomes by Indigenous researchers and stakeholders. IP4.02.01 will generate a roadmap to build relationships between the IP4 team and Indigenous researchers and communities. IP4.02.03 and IP4.02.04 will provide the tools and knowledge to empower government at all levels to undertake a co-ordinated approach to interventions to reduce exposure to air pollution and consequently save lives. Outputs in 2022 that will contribute to this outcome are the improved guidance on the use of high efficiency particulate air (HEPA) filters for air quality in public spaces, guidelines on the selection and use of low-cost sensor networks for the management of local air quality problems and a roadmap for interventions to reduce exposure to wood-heater smoke. Finally, the research in this project will enable government to plan for the impacts of a warming climate on future air quality and to maximise the co-benefits of reducing emissions and improving air quality.

All IP4 projects have established key priorities and actions to support their research in later years, as follows;

- IP4.02.01 established collaborations with other research networks throughout 2022 by initiating discussions with Indigenous partners. The longer-term goals are to ensure that there

is capability and capacity within Indigenous communities to undertake research activities that will benefit their health and environment. The foundational work will also ensure that any future activities are co-designed with Indigenous partners.

- IP4.02.02 endeavours to support the selection of appropriate climate change mitigation policies by demonstrating the benefits of applying a range of climate change policies to improve air quality. These will support the Department in selecting actions to help meet future targets. The foundation work will identify which models are selected for future analyses.
- IP4.02.03 is evaluating a range of mitigation opportunities to reduce exposures to wood heater emissions. This evaluation process will provide the economic and health benefits of implementing different mitigations. These are the foundations for rolling out any national policies around wood heater change out programs. A number of mitigation strategies and discussions with stakeholders is on-going and will be pursued in future years of the project.
- IP4.02.04 has been evaluating the implementation of low-cost sensors and the use of portable HEPA cleaners to support stakeholders and the public. These tools will ensure that appropriate methodologies are implemented in later years of the project. Future evaluations of safe havens to protect the public from poor air quality episodes will rely on the selection of appropriate technologies.

IP5 will realise several longer-term outcomes including:

IP5.02.01 - The metrics and data set established will serve as an underpinning knowledge base for the size of Australia's circularity potential and circularity gap and will allow a prioritisation of actions that can increase circularity. A comprehensive material flow dataset for Australia will be available and regularly maintained to build the backbone of an Australian material flow and waste data architecture for use by policy makers and industries. The dataset will inform the pressure indicators section of State of Environment Reporting and for reporting to the SESA data initiative and the Sustainable Development Goals (SDGs). Australia is a global leader in integrated environmental and economic reporting and the insights of the reporting support national planning and policy.

IP5.02.02: The interdisciplinary science integrating social, economic, engineering and environmental science contributions will assist the corporate sector in identifying innovative business and management strategies that will enable increased value recovery from tyres and conveyor belts. The insights gained and strategies identified will have application beyond Western Australia to other regions that face similar challenges.

The environmental and health impacts of unmanaged used tyres and conveyor belts for remote and Indigenous communities assessed through the qualitative research in 2022 will be relevant for other remote mining-based communities in Australia. The opportunities identified through the research for recovering value locally in Western Australia can inform a national approach for supporting local business and communities. The implementation of the strategies proposed as part of the project is expected to result in improved sustainability outcomes for communities in regional areas through creation of jobs and reduced risks to human and environmental health from end-of-life tyres and conveyor belts.

IP5.02.03: Implementation of the findings in specific regional and remote local government areas in collaboration with relevant local governments, businesses and community organisations will strengthen local decision making. The PhD project commencing in June 2023, titled 'Reducing waste through community-based circular economies in regional Australia', will utilise a case study approach comparing Australian and Brazilian regional local government situations in coastal areas. The research will specifically focus on relationships between local governments and key stakeholders involved in waste management and resource recovery.

IP5.02.04: The project intends to build the research capacity over the shorter term of Indigenous researchers with the aim that the project is led by Indigenous researchers in the future. Moreover, community engagement and short-term project outcomes will enable Aboriginal communities in Western Australia and beyond to create business opportunities while addressing waste problems.

NESP impact stories

NESP impact stories are provided at Attachment B. These stories showcase the contribution of NESP -funded research beyond contributions to academia, including to the environment, the economy, society, culture, public policy and quality of life. Impact stories provided are aligned with our key themes for the Hub of sustainable communities, remote and regional solutions and waste resources.

Collaboration and partnerships

NESP encourages a collaborative, multi-disciplinary approach to environmental and climate research. Key to the success of the Hub will be the capacity to foster partnerships across hubs and with a wide range of decision-makers across the Australian community, including Indigenous communities, to achieve positive environmental, social and economic outcomes.

Co-design is a fundamental pillar in how the SCaW Hub engages in research, from planning and design through to implementation. With the breadth of issues covered by the Hub, comes the need to engage with a wide range of stakeholders and listen and respond to their needs, working closely with our partners to ensure research-user expectations are met and the impact sought, achieved, as shown in Figure 6.

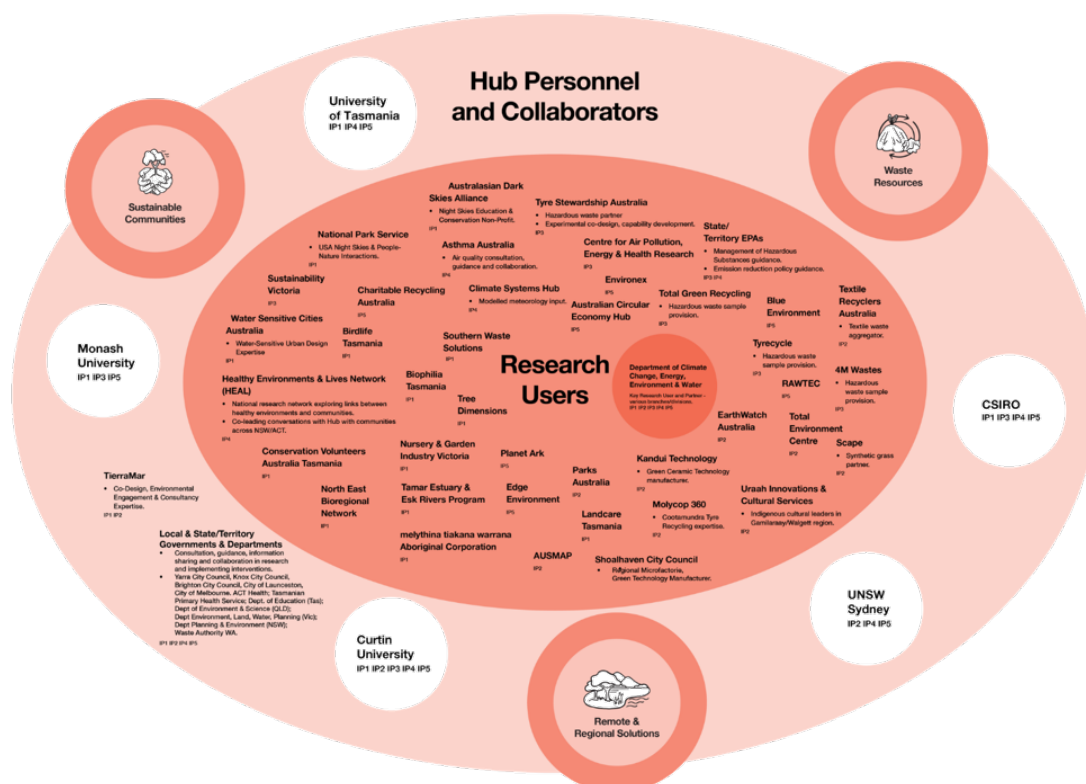


Figure 6: The 2022 SCaW Hub Stakeholder Network, which demonstrates the fluid line between hub collaborators and research-users

The SCaW Hub conducts annual reviews of its key strategies. Strategies are updated by the strategy leader and shared with other strategy leads for comment. All updated strategies are reviewed by the communication manager for consistency and accuracy. Updated strategies are reviewed by the Operations Manager, Hub Leader and Steering Committee Chair and then sent to the Department for approval. In 2022, following review, only minor changes were made to the Knowledge Broker, Indigenous Partnerships, Communications, and Data Management strategies, mostly cosmetic in nature or to update changes in the Department and key responsibilities where changes in Hub staffing had occurred.

Knowledge brokering

The role of the Knowledge Broker is to create, facilitate and translate productive exchanges between people across the spectrum of researchers and research-users, to improve knowledge generation and application.

The Knowledge Broker has played a key role in the Hub over the course of this year, primarily through assisting researchers and their stakeholders in planning and facilitation of co-design workshops as well as in distilling the narratives and impact pathways of their research plans and projects into simplified, user-centric messaging. During delivering or completion of the project, the knowledge broker assisted researchers to communicate the project and its aims and key findings with stakeholders. This has included by transforming key messages into a series of mixed media assets, from written copy and visual imagery, information sheets, short videos, audio and infographics that suit different stakeholders audiences. The production of these assets is still underway, to be ready for Department approval and release in 2023. The knowledge broker team holds regular meetings and discussions with each IP team to understand their needs and how best to support them.

The Knowledge Broker has played an important role during the year in collaborating internally to support other strategic leadership, such as Indigenous Partnerships and Data Wrangling, to enhance the ways they communicate their research and engage with research participants, research-users, and the broader public. Other internal Knowledge Broker support has involved holding regular collaborative sessions, bringing together Hub personnel to share and reflect on the status and direction of their research, and together discuss the Hub's overall impact and direction.

The Knowledge Broker has also stimulated cross-hub collaboration through regular meetings with the Climate Systems, Marine and Coastal and Resilient Landscapes Hubs Knowledge Brokers to share experiences and ideas around translating research and knowledge.

Communication

The Hub's communication strategy guides the communication function in conjunction with the Hub's research plans and the strategies of other hub functions. The role of the communications function is to promote and protect the activities and reputation of the Hub and its partners, while supporting the overall objectives and vision of the NESP.

The Hub's Communication and Media Manager has worked closely with the Hub Host's leadership team on various levels of stakeholder engagement, including with the Department, the Hub's Steering Committee and its Chair, and all research areas across the Hub. This has included regular and targeted meetings and interaction with researchers, collaborating with the other strategy leads, and monthly meetings of the NESP hubs Communications Practice Group, which discusses and shares communications matters relating to all four NESP hubs including publicity, events and insights. The Manager has also participated in the weekly Hub Host Leadership group meetings and interactions.

The Communications Action Plan is the workplan of activities to deliver the strategy and for the 2022 calendar year key activities included:

Branding / templates / materials to support IP areas	<ul style="list-style-type: none"> No new branding or new templates, but delivered various updates via correspondence and in meetings about branding requirements and support provided by Communications function Updated comms support and requirements document to V5 to account for various changes (removal of mission term and the new DCCEEW knowledge product approval process)
Website	<ul style="list-style-type: none"> Website planning, build and development – launched website in February Website maintenance and operation Updates to all mentions of DCCEEW from DAWE Updates to operational changes (eg, personnel changes) Extensive publication of news and event posts Published all new research reports and annual reports Published relevant IP-related sections of research reports for each IP section Website user report analysis, showing various highlight such as: Page acquisitions which show that most viewers come to the site as a result of the social media posts Communications Manager sends linking to new posts and updates DEECCW is the fourth highest referral site to the website Topic three geographic domains are US, Great Britain then Australia, but almost three quarters of users are from Australia Desktop users are 4 times the rate of mobile users
News	<ul style="list-style-type: none"> Wrote and published 20 news items
Events	<ul style="list-style-type: none"> Wrote and published 27 events items
Videos	<ul style="list-style-type: none"> No new videos produced in 2022 but did update and publish the welcome/overview video on website to account for change in Indigenous Facilitator
Social media handles (LinkedIn and Twitter)	<ul style="list-style-type: none"> Wrote and published posts for all website news and event stories – over 50 posts including linking to SCaW Hub site posts and other relevant curated content (such as reposting relevant DEECCW posts) A strong following base across both platforms Leveraging the Hub Leader's profile / social channels of Twitter and LinkedIn to promote the Hub has helped grow our following Thousands of post views each month for an average of 6 posts a month Continue to consider other social channels as the supply of content emerges
Knowledge product support and management of	<ul style="list-style-type: none"> Interacted with DCCEEW on the draft product process (still no input from our KB although was sought) Emailed the Hub leaders with information on the updated Hub communications support and requirements document to V5 to

approval process with NESP	<p>account for the new knowledge product approval process and other updates</p> <ul style="list-style-type: none"> Many interactions with IP1 team over their 2 x products and at end of 2022 and various others researchers for a number of products in development
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Indigenous Partnerships

The Hub's Indigenous Partnerships Strategy, a live document, was endorsed by the Hub's Steering Committee and approved by the Department on 28 September 2021. It was developed by the Senior Indigenous Facilitator in consultation with the Hub Host and reviewed with minor administrative updates made in 2022. The strategy will continue to be revised by the Senior Indigenous Facilitator in discussion with the Indigenous Facilitation Network, the Hub Host and the Department on an annual or needs basis as the Hub evolves and matures.

The strategy, to be implemented by the Senior Indigenous Facilitator, working in partnership with Hub researchers, promotes an Indigenous partnership approach for the Hub that seeks to facilitate appropriate participation by Indigenous Australian people, groups, and communities when undertaking research activities. The Senior Indigenous Facilitator role is a part-time position. The Senior Indigenous Facilitator builds awareness within the Hub of cultural governance protocols such as Indigenous Cultural and Intellectual Property (ICIP) through co-ordinating cultural awareness activities.

The Hub agreed that cultural awareness training is mandatory for all, with the option for Aboriginal and Torres Strait Islander members to opt-in to the training should they choose to participate. In light of this, in 2022, the Senior Indigenous Facilitator arranged training for Hub Members to participate in True Tracks (Indigenous Cultural and Intellectual Property or ICIP) training as outlined in the strategy. Further, in collaboration with the Hub Knowledge Broker, online cultural awareness training from Your Mob Training was purchased and made accessible to all Hub members. The Senior Indigenous Facilitator monitors cultural capability development and ensures that these skills and understandings of ICIP, Indigenous Data Sovereignty and Cultural Governance are embedded in proposed projects. The Hub's projects seek to invest in and enhance Indigenous Australian research capacity, including rural and remote Australian research capabilities. Fostering increased cultural awareness between members of the Hub, the participating nodes, and the communities where we will be conducting our research is critical over the term of the Hub.

In addition to aligning with the Indigenous partnership principles, the partnership approach supports the NESP three-category approach for research projects. The three-category approach recognises there may be differences in how the Hub's research-users are engaged and involved in our projects. These differences could be related to limited capacity, the nature of the research, or the interest in the project's outcomes. Working with Node and Impact Priority Leads, the focus in 2022 of the Senior Indigenous Facilitator, helped to build cultural capabilities to establish and sustain partnerships with Indigenous Australian people, businesses and communities in urban, regional and remote areas across Australia. Through the co-design process, each IP area seeks to incorporate Indigenous Australian research, decision-making, and strategies for meaningful engagement within their research plans, as reflected in the Hub's Indigenous Partnerships Strategy.

The Hub's engagement with Indigenous Australian people, businesses and communities is increasing. Given the limited activity within the first reporting period, foundational skills in cultural awareness and building trust in the community continue to develop. The Senior Indigenous Facilitator has co-ordinated steps to move forward with these activities, which include the attendance of community meetings to promote activities of the Hub, including participation at Danjoo Koorliny, an Indigenous-led

summit about the environment held in Western Australia to align with the timing of cross-hub projects interested in the Swan River region. Further, the Senior Indigenous Facilitator has participated in project team meetings with industry partners to offer advice in developing and designing Indigenous research projects.

The Hub's investment in increasing Indigenous Australian research capability has increased since the previous reporting period. For example:

- Developing an expression of interest process to engage Indigenous academics and students will be finalised in early 2023.
- Following recommendations by the Senior Indigenous Facilitator, a local Aboriginal Elder was procured to provide a Welcome to Country and share knowledge about Indigenous priorities for their community at the Hub planning workshop in 2022.
- The Senior Indigenous Facilitator contributed to a cross-hub Indigenous Facilitation online panel conversation led by the Climate Systems Hub regarding Indigenous Engagement and Research, which was shared with the Hub.
- The Senior Indigenous Facilitator attended the CRC Transformations in Minesite Economies Forum as a guest speaker regarding Indigenous inclusion.
- The Senior Indigenous Facilitator reviewed all proposed projects in the last 12 months to ensure Indigenous inclusion and appropriate engagement activities.
- Through several meetings in the second year, the Hub actively engaged with Indigenous facilitators from the other NESP hubs via the Senior Indigenous Facilitator. This cross-hub Indigenous engagement enables the identification of potential opportunities. Facilitating appropriate training activities is an initial step in building the Hub's cultural awareness.
- The Senior Indigenous Facilitator has actively engaged in governance for the SCaW Hub and NESP more broadly through active participation in Steering Committee Meetings, Hub Meetings, Cross-Hub Meetings, Indigenous Facilitation Network meetings and the continued chairing of the SCaW Hub Indigenous Advisory Committee Meetings. Additionally, the Senior Indigenous Facilitator has attended Knowledge Broker meetings to provide an Indigenous lens where required. Further, the Indigenous Advisory Committee have met consistently throughout the reporting period. During these meetings, the Committee revised the Terms of Reference, and the membership has increased to include a member from the CSIRO, which was previously vacant. The Indigenous Advisory Committee continue to be actively engaged in discussions about the Indigenous Partnership Activities of the Hub.
- The development of Indigenous-led Cross-Hub projects continues. However, the proposed electronic dashboard project has yet to progress due to challenges with the process and a change of staff at DCCEE.

Data management

The Hub's data management strategy, a live document, was endorsed by the Hub's Steering Committee and then approved by the Department on 28 September 2021. The strategy's function has been conceptualising several initiatives to help embed good data management practices across the Hub. It will be revised by the Data Wrangler in consultation with the Hub Host and the Department on an annual or as needs basis as the Hub evolves and matures.

This strategy aims to:

- guide data wrangling activities in the Hub, in particular outlining how the Hub will manage data at all stages of research

- ensure that findable, accessible, interoperable, and reusable (FAIR) principles are embedded in all Hub activities, and that Hub activities are consistent with the NESP data and information guidelines
- provide clarity on the activities that data wrangling actor(s) in the Hub will undertake.

The current Data Wrangler was appointed by the Hub in September 2022. The Data Wrangler's role includes working with the Hub, researchers, the Department, and other stakeholders to translate data and information into relevant databases and tools and to help integrate research outputs into national information repositories, digital systems, and decision-support tools. This includes ensuring the data is produced and used in accordance with the FAIR principles of being discoverable, accessible, and useable, to optimise the use and reuse of public data.

The Data Wrangler will be responsible for coordinating and conducting data discussions with hub researchers, providing guidance on best practice data management, reviewing project data management plans, and tracking data management milestones.

The Data Wrangler will also work with other Hub staff, including the Knowledge Broker and Communication and Media Manager, researchers, and other stakeholders to maximise the usability of the Hub research and increase the accessibility of data to policymakers. The Data Wrangler role is a part-time position.

Key outcomes achieved since September include:

- The data wrangler has had initial meetings with research leaders from IP2, IP3 and IP4. These meetings have been critical in enabling the Data Wrangler to enhance their comprehension of every project and its challenges concerning data management and publication. The primary meetings were equally vital in establishing the Data Wrangler's expectations, especially about NESP-funded data. Notification of the Data Wrangler is required for any generated or published NESP-funded data to guarantee continuous monitoring of data and its status. The meetings with IP1 and IP5 will occur in early 2023.
- The Data Wrangler has also had positive interactions with both the Knowledge Broker team and the Senior Indigenous Facilitator. The meeting with the Senior Indigenous Facilitator was particularly valuable as it drew attention to the gaps in the current data management strategy around the CARE principles. Moving forward, the Data Wrangler will work with the Senior Indigenous Facilitator to better incorporate CARE principles.
- The Data Strategy document was updated to reflect the changes to the Department.

Hub-level risk management

All risks identified in the Hub's risk management plan are being actively managed. There were no

A risk management framework is in place for the Hub, having been approved by the Steering Committee and the Department as a part of the Research Plan 2021 and RP2022 signoff. Risks are identified, managed and reviewed on a monthly basis by the Hub Host leadership team. Risks can be identified through discussions with Node and Impact Priority Leads or through notification from the Department. Where new risks are identified appropriate mitigation measures are developed and communicated to Node and Impact Priority leaders as required. Updates are also provided to the Hub's Steering Committee and the Department as required.

There were no new risks identified for the Hub during RP2022.