Sustainable Communities and Waste

National Environmental Science Program

National Environmental Science Program (NESP)

Sustainable Communities & Waste Hub annual progress report 1 January to 31 December 2024

Contents

Acknowledgement of Country **3**
Letter from the Hub Leader **4**
Management **7**
Research **9**
Progress towards research delivery 12
Research projects 21
Cross-cutting initiatives 27
Emerging priorities 28
Performance against milestones **29**
Performance against funding agreement milestones 29
Performance against the research plan milestones 29
Measuring success **29**
Hub outcomes and outputs 29
NESP impact stories 54
Collaboration and partnerships **54**
Knowledge brokering 57
Communication 57
Indigenous partnerships 60
Data management 60
Hub-level risk management **61**

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

I am pleased to present the 2024 Annual Progress Report for the Sustainable Communities and Waste (SCaW) Hub. The year of 2024 has been a period of significant progress with our various multi-year research projects which are generating high impact outcomes with our many stakeholders, reflecting our commitment to enhance sustainable communities and reduce negative waste impacts.

The SCaW Hub, a consortium led by the University of New South Wales, Sydney (UNSW Sydney), in collaboration with CSIRO, Monash University, the University of Tasmania, and Curtin University, continues to be a pivotal force in environmental and climate research. Our research agenda, co-designed with the Department of Climate Change, Energy, the Environment and Water (DCCEEW) and other research-users, addresses critical sustainable community and waste issues across urban, regional, and remote Australia. Our vision is to improve the health, resilience, connectedness, and prosperity of communities while minimising environmental impacts.

Our 2024 research outcomes demonstrate strong alignment with the revised *National Waste Policy Action Plan 2024* and the new *National Circular Economy Framework*, reaffirming the SCaW Hub's commitment to the national objective of creating a sustainable circular economy.

The Hub's engagement with the Circular Economy Ministerial Advisory Group (CEMAG), principally through Paul Klymenko, a member of our Steering Committee and the CEMAG, ensured that our research direction remains tightly integrated with national circular economy priorities.

Through research conducted under IP2 and IP5, the Hub has contributed essential evidence and tools to enhance circularity metrics, including a time series of Australia's circularity rate and material footprint now embedded in Treasury's *Measuring What Matters* framework.

Our work on fit-for-purpose recycling technologies for regional and remote communities has operationalised the principle of place-based circularity, helping to overcome barriers to localised secondary material recovery. These outcomes directly support action areas under the National Waste Action Plan, particularly those relating to increasing the use of recycled content.

Our collaborative work with Standards Australia, state agencies, and industry actors has enabled the co-design of scalable technological frameworks and intervention strategies—particularly in microplastics monitoring, synthetic grass pollution reduction, and rubber recovery from tyres. These projects not only enhance materials stewardship but also support innovation in remanufacturing and local economic development—central themes of the *National Circular Economy Framework*.

Across all thematic areas—waste resources, sustainable communities, and remote and regional solutions—the Hub continues to deliver practical, data-informed pathways toward a circular, low-impact future, in full alignment with Australia's environmental, social and economic sustainability goals.

Delivering Outcomes

The SCaW Hub has now completed four years of operation, and over 2024 made substantial progress of its research projects and community engagement which are all focussed across three thematic areas: sustainable communities, remote and regional solutions, and waste resources.

Our projects aim to help solve key challenges, including for hard to recycle waste materials like e-waste and tyres; developing methodologies to better understand and find solutions for microplastics; identifying practical solutions and alternatives to combat the impacts of woodfire heater smoke, particularly for Indigenous communities; working with regional and remote communities to develop more effective ways to empower their voice and sovereignty in water management; and helping the nation to develop a circular economy where waste is used a resource.

The Hub research operates across five Impact Priority areas: IP1 - Sustainable people-environment interactions; IP2 - Plastic and Waste Materials; IP3 - Hazardous waste and pollutants; IP4 - Air quality; and IP5 - Waste impact management research.

Key highlights from our co-designed research projects in 2024 have included:

- **IP1**: The team continued to analyse data from the 2023 national survey on nature connection and released the first co-designed products of findings. A report on inclusive urban greening was launched in collaboration with the Climate Systems Hub, focusing on heat impacts in Sydney. The Aqua Nullius program continued national engagement with First Nations water leaders through a series of workshops designed to support First Nations water leaders in identifying processes for ongoing resistance.
- **IP2**: Research contributed to the development of a consistent monitoring protocol, refining methodologies for detecting and quantifying microplastics across different environmental settings. Throughout the year, research-user engagement remained central to the progress of the team's projects, ensuring alignment with policy priorities and waste management strategies at local and national levels. Our work under this IP has created engagement at the national level with various federal government branches, state governments, local LGAs, and various community groups. We have also fostered engagement with young generations and students, as well as bodies such as Standards Australia. To ensure practical and region-specific discussions and potential solutions, different workshops were designed and conducted, often at regional conferences, and the team engaged many stakeholders in co-designing a circular technology framework that was produced.
- **IP3**: A co-designed methodology framework for preliminary ecotoxicology assessments was prepared to facilitate the generation of data related to the effects of waste chemicals on relevant environmental receptors. Enhanced networking with recyclers, industry, and other associated government agencies ensured broader co-design and translation of outcomes.
- **IP4**: Yarning circles commenced in NSW Indigenous communities to understand who within the communities are at risk from poor air quality, specifically landscape fire smoke emissions. Progress was made with the three intervention studies identified under project IP4.02.03. Data from the two Discrete Choice Experiments was collected from a general population and a wood heater owner group.
- **IP5**: Data delivery for the circular economy metrics of the Treasury's Measuring What Matters framework included time series for Australia's circularity rate, material footprint, and material productivity from 2010 to 2023. The project explored Indigenous-led circular economy business models, to help create pathways for economic development and employment within Indigenous communities.

Creating Impact

The Hub has been at the forefront of national waste management initiatives. As the Hub Leader, I have been actively engaging various industry, local and state governments, community groups as well as various national bodies and media outlets to share not only the work of the Hub, but to listen to all of these stakeholders and incorporate into Hub work relevant feedback and input as part of our community engagement.

For instance, I travelled to Central Australia and visited a local school and community, delivering speeches and attending closed meetings. I also spent a few days in Arnhem Land engaging with different ranger groups from across the country to understand their needs. And I travelled to numerous rural and regional council areas to engage with local communities, including the NSW Local Government Annual Conference in Tamworth, to help prosecute our agenda of achieving sustainable communities and reducing the impacts of waste. I also gave time participating in dozens of webinars and other online forums and was featured on multiple occasions by ABC News and various other media outlets to discuss matters related to soft plastic recycling.

Overall, the SCaW Hub strongly helps to deliver:

- **Enhanced Collaboration**: By providing a collaborative space for academics, government, industry, and the community, we foster partnerships that drive sustainable outcomes.
- **Innovative Solutions**: Our research addresses pressing environmental challenges, offering innovative solutions that are both practical and scalable.
- **Community Empowerment**: Through our projects and outreach, we empower communities, including Indigenous groups, to take an active role in sustainable development and waste management.
- **Policy Influence**: Our evidence-based research supports the development of policies that promote sustainability and resilience, benefiting society at large.

As we move forward, we remain committed to our mission of driving positive environmental, social, and economic outcomes. I extend my gratitude to all our partners, researchers, and stakeholders for their continued support and collaboration and look forward to another year of continued, strong progress.

Yours sincerely

Prof Veena Sahajwalla, Hub Leader

Management

The National Environmental Science Program (NESP) is a long-term commitment by the Australian Government. The program funds environmental and climate research. The second phase of NESP (NESP2) builds on the foundations of past work, and funds 4 research hubs from 2020–21 to 2026–-27.

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 Sydney). 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 fourth year in 2024. This year has been a consolidation of the codesign process, with all projects now well into implementation phases. This year also saw the identification of another emerging priority, approved by the Department in December 2024, to redirect bio-waste away from incineration, towards utilisation as a valuable remanufacturing resource. Governance processes and operating systems continued to be strengthened and refined in 2024, 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 30 May 2024, Dr. Dixit Prasher stepped in to the role of SCaW Hub Operations Manager.

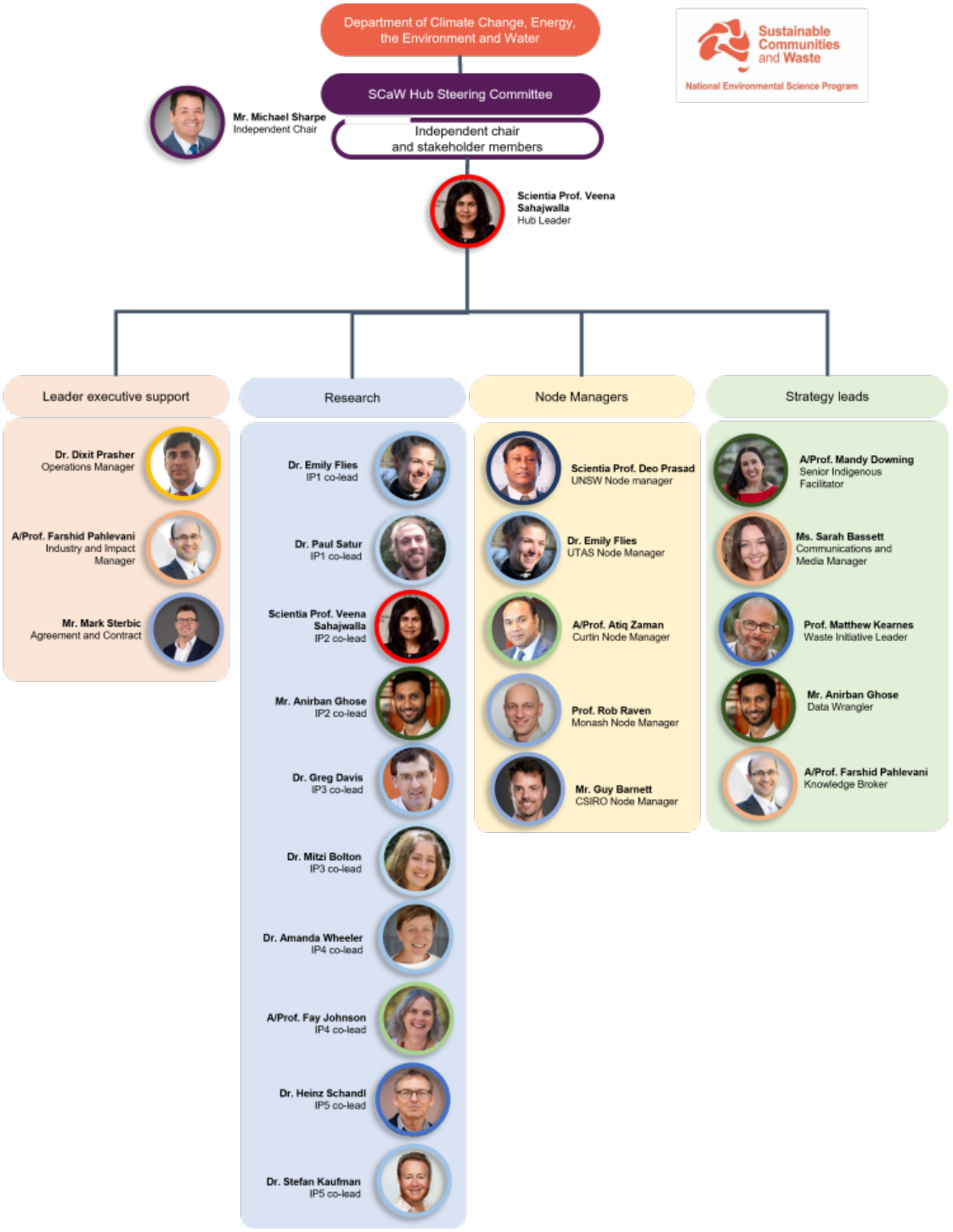

Figure 2: 2024 SCaW Hub Operational and Governance Structure

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 accessible at Australian Government and hub websites.

Key Thematic Areas

SCaW Hub research impacts, as shown in Figure 3, are delivered across three thematic areas:

- **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 across Australia, in remote and regional communities as well as urban environments. This theme focuses on building economies of purpose rather than purely economies of scale.

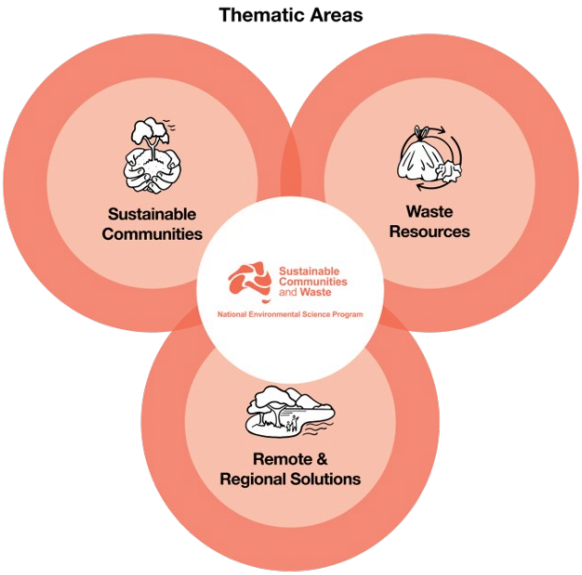

Figure 3: SCaW Hub 3 Key Thematic Areas

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 processes, starting with our very first Research Plan, RP2021/2022. Projects are led by collaborations of researchers from across all Hub institutions, and involve input from research users and partners. Our projects and thematic areas are mapped in Figure 4, with more detail provided in Attachment A.

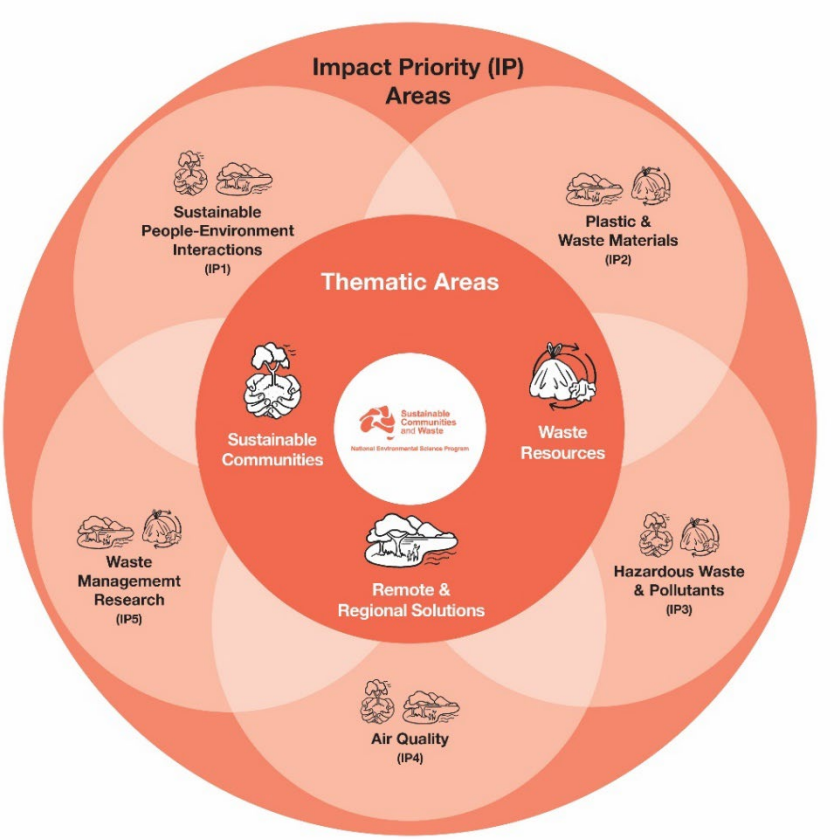

Figure 4: SCaW Hub 3 Key Thematic Areas and 5 Impact Priority (IP) Areas

IP1 - Sustainable People–Environment Interactions

IP1 explores links between human wellbeing, and environmental and ecosystem health. Through research and collaboration with various stakeholders 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 also aims to empower regional, remote and Indigenous communities to become more sustainable and to improve liveability. 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

IP2 – Reduced Impact of Plastics and Other Materials

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 policies related to the modernisation of recycling and manufacturing capability, the protection of national materials supply and to develop a circular economy. Additionally, *The Circular Advantage* report recently produced by the Circular Economy Ministerial Advisory Group (CEMAG), a member of whom sits on the SCaW Hub's Steering Committee, highlights the importance of using waste resources for remanufacturing.

Thematic Areas

- Waste Resources
- Remote & Regional Solutions
- Sustainable Communities

IP3 – Management of hazardous waste, substances and pollutants

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

IP4 – Improved Air Quality, Forecasting and Assessment

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

IP5 Waste Impact Management Research

IP5 focuses on providing information, data and management tools; informing design for repurposing waste and to achieve a 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

HIP.04- Hub Indigenous-led Project

HIP project is our flagship Indigenous-led project that hardness the collaboration between First Nations Communities and our hub researchers from Impact Priority 2 (Plastics and other wastes).

Key Projects

HIP.04.01: Remanufacturing Plant and Plastic Wastes in Regional and Remote Communities

This project aims at harvesting invasive native and introduced species of plants from landscapes as part of restoring the health and identity of the natural environment and local Indigenous communities. This project will explore the viability and potential use of the selected waste feedstock prototype/s along with estimates of economic viability for potential use within the manufacturing industry.

This project is not commenced in 2024 and moved to 2025 due to delay in in contract execution between Firesticks and UNSW.

Thematic Areas

- Waste Resources
- Sustainable Communities
- Remote & Regional Solutions

Progress towards research delivery

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

Both multi-year projects continued their progress this year, working with partners and collaborators to address research-user priorities.

IP1.02.01: Nature connection

In 2024 this project completed several knowledge products and had impactful outcomes across our three research streams:

Stream 1: Nature Connection (Survey/Storytelling)

In 2024, we continued to analyse data from the 2023 national survey on nature connection and have released the first co-designed products of findings. We presented about this work at several venues, including academic conferences and DCCEEW spotlight on science series and also submitted several academic papers which are currently working their way through the review and publication cycle.

In the Storytelling project, our focus in 2024 was on collecting stories from diverse communities across Tasmania. In late 2024, we were able to start on the qualitative analysis of the stories, which will be

the main focus for 2025. We created a report so that others could learn from the framework and methods of the Storytelling Project.

Stream 2: Nature-based solutions & greening

In 2024, we completed report on inclusive urban greening, and launched cross-Hub collaboration with the Climate Systems Hub looking at heat impacts in Sydney.

Stream 3: Indigenous-led research

In 2024, we met several times with our research partners the Melaythenner Teeackana Warrana Aboriginal Corporation (MTWAC) to shape up this cross-Hub collaborative, Indigenous-led research. These efforts resulted in the formation of a steering committee, a signed research contract and an ethics submission. We also received additional funding to expand this research into understanding climate impacts on wellbeing and opportunities for climate adaptation. The research will begin in earnest in 2025, once the ethics has been fully approved.

IP1.02.02 Water Sensitive and Liveable Communities

The IP1.02 Program has progressed research outcomes in both regional and remote communities and aqua nullius program streams throughout the January to December 2024 period. The regional and remote communities' program has finalised outputs following a 2-year consultative period throughout Australia in understanding remote and regional servicing needs, priorities and opportunities. We have also established the first in a series of place-based living laboratory-style arrangements to progress research aims, in partnership with Anagu Traditional Owners, Parks Australia and supporting organisations for the establishment of an Anangu led water plan for Uluru Kata Tjuta National Park. These will serve to inform priorities and process for ensuring a national platform of capability building that is fit for purpose.

The aqua nullius program has continued national engagement with First Nations water leaders through a series of workshops designed to support First Nations water leaders to identify processes of aqua nullius and establish processes for ongoing resistance. It has further sought to engage key non-Indigenous allies such as leading state and federal government staff in similar 'settler state' workshops and yarning processes to support and inform future First Nations led and planned processes for the invigoration of First Nations knowledge and science in water governance. Key outputs from these processes have been developed into NESP reports and are now informing plans for a water camp gathering in 2025 comprising days for both Indigenous-only and both Indigenous and non-Indigenous water leaders and practitioners to gather, yarn and consider steps for progressing the objective of this research program

Finally, in supporting alignment with NESP's Three Category approach, a small scoping panel of First Nations water leaders has been established to consider the requirements and architecture for a First Nations research advisory body that will oversee all NESP IP1.02 research and program related processes for the future.

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

IP2 aims to reduce the environmental and social impacts of problematic waste materials by developing research-driven solutions for plastic pollution and waste management. The program informed by national priorities, including the National Waste Policy 2018, the 2019 National Waste Policy Action Plan and 'The Circular Advantage' report from the Circular Economy Ministerial Advisory Group

(CEMAG), has produced research to inform policy, improve recycling infrastructure, and strengthen circular economy pathways.

In 2024 both projects continued implementation of the project, working with key research-users from the Department, industry and community groups, including both Indigenous and government, building on the foundational work in previous years.

IP2.02.01: Understanding Microplastics

In 2024, the Understanding Microplastics project continued to build capability in monitoring and mitigating microplastic pollution, focusing on high-risk sources such as tyre dust and synthetic grass. The research contributed to the development of a consistent monitoring protocol, refining methodologies for detecting and quantifying microplastics across different environmental settings.

Key partnerships with Ocean Protect and Sea Shepherd facilitated data collection and validation, improving knowledge of microplastic prevalence, transport pathways, and environmental impacts. Research efforts also supported pilot studies evaluating interception technologies, with a particular emphasis on stormwater filtration systems designed to capture tyre wear particles before they enter waterways.

A significant component of the project examined synthetic grass as a source of microplastic pollution, assessing its composition, degradation mechanisms, and pathways into stormwater systems. The findings informed potential interception pilots to investigate mechanisms of reducing the impact of synthetic turf.

Throughout the year, research-user engagement remained central to the project's progress, ensuring alignment with policy priorities and waste management strategies at local and national levels. The findings will support future microplastic mitigation efforts, regulatory frameworks, and technological innovations aimed at reducing the environmental impact of microplastics in Australia.

The project also conducted a comprehensive review of existing Australian research on microplastics in various environments, including sediments, indoor air, road dust, fresh water, marine water, and living organisms. It summarised microplastic characteristics such as polymer type, size, shape, and abundance in different samples, and provided a detailed description of the sources, fates, and entry routes of microplastics into terrestrial and aquatic environments. The systematic presentation of the effects of microplastics on humans, organisms, and ecosystems highlighted their role as carriers of persistent organic pollutants and micropollutants, disrupting the physiological functions of organisms. The project examined current Australian initiatives, such as plastic bag bans, single-use plastic restrictions, and container deposit schemes, and identified a lack of specific microplastic legislation in Australia. Policy recommendations were made for the Australian Government to specifically address microplastics pollution, raising awareness about the significant environmental and health risks posed by microplastics, especially due to their ability to transport harmful chemicals. The project emphasised the need for further research on microplastics' generation, migration, and risks, particularly in the context of Australia's unique environmental challenges.

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

In 2024, IP2.02.02: Finding Fit-for-Purpose Technological Recycling Solutions advanced its efforts to support regional and remote communities in investigating scalable, locally tailored recycling solutions. Building on the foundation set in 2023, the project continued refining its technology roadmap, which

assesses current and emerging waste processing technologies to identify viable recycling solutions for different waste demographics.

A key milestone this year was the Dubbo and Forbes workshops, where local councils, industry representatives, and academic stakeholders participated in co-designing elements of the circular technology framework. These workshops provided critical insights into the challenges and opportunities faced by regional communities, ensuring that proposed recycling technologies align with real-world needs.

These demonstration workshops served a dual purpose: first, as a form of ground-truthing that validated the proposed recycling technologies in real-world, region-specific conditions; second, as a mechanism for capacity building through co-designed knowledge exchange. Community engagement in the production of 3D printing filament and housing materials from local waste showcased scalable innovations and generated valuable stories and lessons. These are now being translated into case studies, decision-support tools, and factsheets to support adoption by other regional councils and communities. Such practical outputs are accessible through the Hub's website and stakeholder engagement events.

Significant progress was made on the development of a waste management dashboard and decision-support tools, designed to assist local governments and businesses in selecting appropriate technologies, infrastructure, and investment strategies. These tools consolidate data on waste flows, processing capacity, and circular economy opportunities, supporting more informed decision-making.

Additionally, the project expanded its demonstration case studies, working closely with regional councils and industry partners to evaluate on-ground recycling technologies. These case studies provide practical insights into implementation challenges, economic feasibility, and potential scalability, strengthening the project’s ability to deliver evidence-based recommendations.

Various workshops and discussions were held with federal, state, and local governments, community groups, and students to ensure broad stakeholder engagement. Demonstrations of producing products from Australian waste using Australian technology, such as making 3D printing filament from waste hard plastics destined to landfill, showcased the potential for local waste to be repurposed into valuable products. The project also collaborated with different sections of state and federal governments to produce products from waste plastic for use in housing projects, demonstrating the feasibility of using local waste in sustainable housing. Numerous papers and presentations were delivered to share findings and promote the adoption of fit-for-purpose recycling technologies and solutions.

Looking ahead, IP2.02.02 will focus on scaling pilot interventions, refining policy recommendations, and strengthening industry collaborations, ensuring that regional and remote communities have access to fit-for-purpose recycling solutions that support long-term sustainability and circular economy goals.

Across both sub-projects, demonstrations are functioning as intended—providing ground-truthing for technologies and generating actionable insights, stories, and tools that actively support other communities in their transition to circular and sustainable waste solutions.

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

IP3.02.01: Quantifying mass and potential release of chemicals of potential concern in our wastes and recovered resources)

The research generated by the IP3 multi-year project continues to build the foundation for waste and chemical risk assessment in Australia, aligned to international best practice and informed by scientific literature and co-design with key research users. Key outcomes for the research project in 2024 include:

- A new leaching method, designed to assess the passive availability of chemicals from products containing recycled content, established in partnership with industry. The method has been prepared for publication.
- A co-designed methodology framework for preliminary ecotoxicology assessments prepared to facilitate the generation of data related to the effects of waste chemicals on relevant environmental receptors. The methodology framework has established a decision-tree to enable researchers to prioritise chemicals and waste products for further assessment and underpin the reporting of data to research users. As a result of a critical review of the literature, several experimental variables were identified that require further investigation to support ecotoxicological assessment of waste chemicals in Australia.
- A live data workbook tracking all data generated in IP3. The data is captured and stored in accordance with the FAIR Guiding Principles and Environmental Information Standards.
- Networking with recyclers, industry and other associated government agencies to ensure broader co-design and translation of outcomes.
- Research priorities for RP2025 were co-designed with researchers and end users (DCCEEW, NSW EPA and EPA Victoria) and these were approved by the NESP Hub Steering Committee as part of IP3's ongoing research strategy.
- A co-presentation with DCCEEW about the co-design process between DCCEEW and the IP3 research team given at the NESP conference (March 2024).
- All milestones proposed for 2024 have been achieved.

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

During 2024, a range of activities commenced for each of the four projects under IP4.

IP4.02.01: Let's yarn about smoke

Building on the relationships that were made resulting from the Key Thinker's Forum in March 2023, IP4.02.01 applied for funding from the CSIRO Indigenous Research Grant (IRG) and was successful. The funding allows us to leverage two other Indigenous projects funded by MRFF Indigenous Health (NT) and Asthma Australia (NSW) which are investigating Indigenous experiences with air quality. Yarning circles have commenced in NSW Indigenous communities to understand who within the communities are at risk from poor air quality, specifically landscape fire smoke emissions, and how the community would like to be advised of potential poor air quality episodes using the CSIRO Air Quality Forecasting model (AQFx). Additional yarning circles are being planned for NT and WA. A WA Indigenous researcher was identified through the Kid's Institute, additional funds were provided by CSIRO IRG to support her time. Contracting for an Indigenous research fellow and two Indigenous research officers has been completed.

The findings from the yarning circles will contribute to a wider project investigating how smoke forecasting is used by different States and Territories for the support of priority populations to reduce their exposures to smoke and the resulting health risks. This will hopefully result in a communications framework outcome that can be applied nationally for the management of landscape fire smoke emissions to reduce exposures to smoke.

Mapping of nationally relevant Indigenous research activities related to Indigenous health and air quality was completed with a final map uploaded to the SCaW website. This

Mapping of nationally relevant Indigenous research activities related to Indigenous health and air quality was completed with a final map uploaded to the SCaW website. This output was created to enable improved communications between researchers so that communities were not overburdened with research requests. It also ensures that where reasonable, researchers and communities will be able to leverage existing projects.

In November 2024, a presentation of the project was made at the Healthy Environment and Lives (HEAL) annual online conference.

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

Model runs for the current period (4 x 5 years), and the 'climate penalty experiment' for the 2050 period (8 x 5 years) have been completed. These runs have been analysed and used in the drafting of technical report on Air quality and Communicable Diseases that leveraged some of modelling findings. Research article "Quantifying natural emissions and their impacts on air quality in a 2050s Australia was submitted in 2024 to the journal of Atmospheric Environment and will be reported in 2025

Following presentations were delivered in 2024:

- Invited talk at Gordon Research Conference on biogenic hydrocarbons and the atmosphere, Barcelona Spain, June 13th, 2024.

- ACCOMC meeting. "Meteorological drivers of air quality in 2050: ventilation, washout and natural emissions", Aspendale. November 14th,2024.

In order to investigate the changes that a warmer climate might have on air quality we will need a simulation using the present-day anthropogenic emission inventories in conjunction with the range in climate outcomes for 2050. This range in outcomes should cover a range of meteorological changes, eg wind speeds, boundary layer heights, rainfall and cloud cover. The experiment will separate out the climate change impacts (e.g. temperature, humidity cloud cover (for changes to photolysis rates) and wind speed) from those occurring due to anthropogenic/land use emission changes.

Given that the increase in natural emissions such as biogenic volatile organic compounds, sea salt and dust due to climate change will form a new 'background' concentration onto which the anthropogenic pollutants will add, there is a strong requirement to understand first what this new background level could be in Australia.

This experiment has also shown us what the ventilation, dilution and atmospheric transport states of the 2050 atmosphere are like in each of our cities. Reducing pollutants could have zero impact if air mass stagnancy is predicted, which is something the southern states will be subject to more of in future winters.

Atmospheric chemistry is not a linear system. The work conducted in IP4.02.02 has generated the new 'background' in air quality for the 2050 period, so we will have a better understanding of changes occurring in the model as a result of emission reduction measures.

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

Progress was made with the three intervention studies identified under IP4.02.03. Data from the two Discrete Choice Experiments was collected from a general population and a wood heater owner group.

The wood heater changeout project funded by Asthma Australia finalised the methodology with Armidale local government (NSW) and now has ethical clearance from the University of Tasmania. The changeout of wood heaters and their replacement with reverse cycle air conditioning units will commence prior to winter 2025 in 25 homes. This will provide a methodology that can be applied more widely by local governments as funding becomes available to reduce wood heater usage and associated emissions nationally. The aim is to contribute to policy changes that will change wood heater use practices.

The Mt Barker SA project involved co-designing a communication intervention to increase community awareness of the impact of smoke from wood heaters and increase uptake of alternative heating technologies. Three activities; two world café workshops and one focus group discussion were held during 2024. Participation was open to Mt Barker district council community members who were wood heater users and were interested in working with the Mt Barker council to design wood heater smoke interventions. A total of 29 community members and two council members took part in the world cafés and focus group discussions. The first world café was effective in generating ideas for interventions to reduce wood heater smoke pollution. However, not all the suggestions were feasible and some met resistance, especially suggestions that restricted wood heater usage. The focus group enabled community members to identify their preferred intervention and along with feedback on how to improve it before piloting in the broader community. At the second world café, participants shared their feedback on the piloted intervention “the Chirpy Chimney campaign”. The participatory research approach was effective for generating and refining ideas and fostering community engagement. However, there is need for ongoing collaboration between the community and local government to build trust and encourage change.

The third intervention will be a co-designed behaviour change intervention to reduce woodheater emissions in Snug, TAS. Partnering with Sustainable Tasmania, the low-cost air quality monitoring has commenced. Funding will support a PhD candidate to undertake the research this coming winter.

Baseline air quality monitoring in Launceston, TAS has commenced with seven low-cost monitors being installed around the city to track particulate air pollution sources and trends. Monitoring is also being conducted in Canberra, ACT. Presentations have been made at the HEAL annual online conference.

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

The review of the HEPA cleaners was completed and a plain English guide developed.

A commentary paper was submitted on ‘Community cleaner air spaces during landscape fire events: What do we know?’ to Australian and New Zealand Journal of Public Health and will be reported in 2025

Seed funding was secured from the CRE Centre for Safe Air to conduct pilot testing of potential cleaner air shelters in Canberra. Seven libraries have had air quality monitors installed to track indoor air quality. Outdoor air quality is being monitored in collaboration with the Dept of Health ACT at one of their regulatory monitoring stations. A building survey is in development with input from Health Canada, Centre for Disease Control, British Columbia and team members. Additional indoor air quality monitoring is being conducted in a Sydney, NSW shopping mall to evaluate these venues for future use as safer air havens.

A grant application was submitted to NHMRC Targeted Call for Research (TCR) into climate-related health impacts and effective interventions to improve health outcomes. The proposed study aims to holistically assess the effectiveness of community resilience centres in reducing exposure to heat and smoke, the health benefits and costs of such centres, and their implementation challenges and scalability opportunities in fast-growing, heavily affected suburbs in Western Sydney and Canberra.

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

Progress was made during 2024 on the four research projects developed in 2022 through stakeholder engagement and co-design.

Project IP5.04.01: Metrics, data and indicators for material flow and stocks, waste and emissions to monitor progress of Australia's circular economy transition

This was a new project to build on the work undertaken under IP5.02.01. This activity was recommended in July 2024 as part of RP4 research activities and aims to extend the national material flow data and circularity metrics (which were outputs of RP2) to individual states and territories, as well as to establish a time series covering 2012–2022.

This work is being conducted in close alignment with the Circular Economy Policy team at DCCEEW and is part of our ongoing engagement in the development of the National Circular Economy Policy Framework, including the selection of indicators and targets. We are also collaborating closely with state governments, having held meetings with Sustainability Victoria, Recycling Victoria, and DCCEEW Victoria, as well as with Green Industries South Australia and the Queensland State Government.

Between July and December 2024, the team has focused on establishing domestic extraction datasets for all states and territories, covering four main material groups—biomass, fossil fuels, metal ores, and non-metallic minerals—as well as 65 individual materials, in accordance with international accounting standards. Unlike in many European and Asian countries that have spearheaded material flow accounting, many of the relevant statistical datasets required for state-level material extraction in agriculture, forestry, fisheries, mining, and quarrying are not centrally collected in national datasets. Instead, they must be sourced from diverse channels, making this work a time-consuming endeavour.

In addition to progressing the RP4 work program, the team has provided data for Australia's circularity rate, material footprint, and material productivity within the Treasury's Measuring What Matters framework for the circular economy data domain.

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

In 2024, best practice case studies for overcoming barriers and increasing value recovery from end-of-life tyres (EOLTs) and conveyor belts in Australia were reviewed. The review encompassed product stewardship schemes in Canada, Chile, several European countries, and New Zealand; recycling enablers like waste classifications and quality standards; technologies for value recovery from EOLTs and conveyor belts; end markets for tyre-derived products, and strategies for communicating with Indigenous communities. Key recommendations included making the Australian voluntary tyre stewardship scheme compulsory or at least co-regulatory, introducing a recycling fee as part of the price of new tyres and conveyor belts, and banning landfilling and on-site disposal of EOLTs and conveyor belts.

Currently, classification systems for EOLTs vary across Australia, and waste conveyor belts are not classified as controlled waste in Australia, leading to inadequate monitoring and lack of data on arisings, transport, and the fate of waste conveyor belts. The stewardship scheme could also be extended to include rubbery conveyor belts. Enablers critical to the successful development of recycling technologies and market pathways include consistent waste classifications, quality standards, traceability, enhanced collaboration across the value chain and recycling hubs or ecosystems.

To foster circular economy solutions effectively, it is crucial to maximize the material value of EOLTs and prioritize waste hierarchy in product markets. End-markets need to be created or reinforced in Australia for retreading, upcycling, recycling of EOLTs and conveyor belts. Reverse logistics will likely play a crucial role in managing rubber waste, potentially facilitated through the adoption of Industry 4.0 (advanced information technologies and robotics) technologies. Prioritising and investing in technologies should be aligned with circular economy principles. This will be enabled through holistic value chain assessments such as value retention models, cost/benefit comparisons, life cycle assessments, and material circularity indicators.

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

The focus for 2024 has been reporting on the national survey of comparing urban and regional/remote local government experiences of CE innovation, and beginning the next phase of work. The survey found that regional and remote CE initiatives are distinctly different from urban examples, and generally less progressed, indicating a need for intervention to support sustainable regional economic development while addressing problematic waste streams.

Engagement over the year with DCCEEW's CE policy team helped inform a partial pivot to the research proposed in RP2025 – shifting the focus to exploring if regional initiatives can bolster and boost lagging CE initiatives in regional and remote Australia, and the role of different actors, including national, state and local government, in seeding them where they are missing, boosting them where they are faltering, and mainstreaming them when they are thriving. This has led to the modifications proposed in RP2025, which build on the research design, waste analysis and survey work from RP2025, but take it in a new direction. This year has also seen the early retirement of former project lead, Associate Professor Ruth Lane, and hand over to Dr Kaufman for Monash's leadership of the project. Associate Professor Lane is finalising a journal paper based on the 3 case studies research project in 2022. While this particular deliverable is delayed as a result, the main significance of the paper is for academic dialogue and general policy evidence. Meanwhile, initial outputs from the study have been shared with local partners, and results reported in the 2022 annual report were also shared with them. The 2023 Circularity conference presentation included findings from this material. Overall, the impact of this delay on stakeholder priorities is minimal.

Engagement in Shepparton involved sharing the results with representatives of local industry, the Greater Shepparton Council, Victorian Department of Environment, Energy and Climate Action, Sustainability Victoria, and CSIRO and discussing their implications for a nascent regional CE initiative, which is a candidate for further developing in the RP2025 work.

IP5.02.04: Identifying opportunities from waste management and resource recovery and the circular economy for Indigenous communities and businesses

As part of Project Milestone 2 (IP5.02.04-D2), the project successfully conducted yarning circles (group discussions) with community representatives and Elders of the Whadjuk Noongar people in

Armadale City Council, Western Australia. Five yarning sessions were held, with up to six Indigenous participants per session. These discussions effectively identified key challenges, and the preliminary findings were presented at the SC&W Hub Steering Committee meeting and the end-user workshop session. The draft interim report outlining these findings was also shared with the end-user for feedback.

During Phase 1 yarning sessions, two suggestions were put forward by the Elders and community participants: (ii) conducting a field visit to understand the challenges of waste littering and (ii) conducting young community groups to understand their perspectives, which was not part of the initial research plan. To support Indigenous self-determination and leadership within the project, two field visits were arranged as part of the yarning activities, providing firsthand experience of waste littering challenges in regional bushland. In response to a suggestion from the Elders, the project also engaged young Indigenous participants by conducting two additional yarning sessions, facilitated by the Champion Centre, to incorporate youth perspectives on waste management and circular economy opportunities.

Moving forward with Milestone 3 (P5.02.04-D3), the project is expanding the yarning circles to include Indigenous-owned and affiliated businesses. These discussions will explore current business practices and potential circular economy solutions tailored to Indigenous enterprises. The findings from these sessions are currently being compiled and analysed, with a final report scheduled for completion by May 2025.

This ongoing work reinforces the project's commitment to Indigenous engagement, leadership, and sustainable waste management solutions while fostering economic opportunities within Indigenous communities.

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 progress for each major 2024 deliverable across IP areas and Hub:

Responsible IP Area	Deliverables/milestones	Date completed/ Partially completed	Status & Comments
IP1.02.01	Report on strategies for equitable urban greening and nature connection in regional communities	31 December 2023	Completed. This milestone completion is reported in 2024. Report generated and uploaded on the Hub's website after DCCEEW approval.
IP1.02.01	Workshop and report on collecting nature-connection stories	31 March 2024	Completed. Report generated and uploaded on the Hub's website after DCCEEW approval.
IP1.02.01	Annual report on project's RP2023 activities	07 April 2024	Completed

Responsible IP Area	Deliverables/milestones	Date completed/ Partially completed	Status & Comments
IP1.02.01	Detailed project RP2025 developed	29 August 2024	Completed
IP1.02.01	Indigenous-led project commenced	31 August 2024	Completed – this project commenced early in 2024 and over the process of multiple meetings, by the end of 2024, a steering committee was formed, and a research contract was signed.
IP1.02.01	Report and infographic characterising nature connection and benefits in Australia	31 December 2024	Completed. One factsheet and two Short reports generated and uploaded on the Hub's website after DCCEEW approval
IP1.02.01	Story-telling data collection begun with second community (young people)	31 December 2024	Completed – we collected numerous stories from young people in 2024. We are still collecting stories in 2025 and working on analysing them.
IP1.02.02	Workshop reports	November 2023 (actual)- delayed to 10 May 2024	Completed. This milestone completion is reported in 2024. Report generated and uploaded on the Hub's website after DCCEEW approval.
IP1.02.02	Convening of a colloquium shaped by the above workshop 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 enfranchisement of Indigenous water science and governance.	February 2024 (revised Date April 2025)	Postponed until 2025 due to referendum outcomes, sorry business and consultation fatigue of First Nations water leaders. This has been repositioned in RP 2025 as Milestone 9 scheduled for April 2025 and is on track for delivery.
IP1.02.02	Colloquium report	March 2024 (revised Date April 2025)	This has been repositioned in RP 2025 as Milestone 10 scheduled for April 2025 and is on track for delivery.
IP1.02.02	Annual report on project's RP3 activities	April 2024	Completed
IP1.02.02	Co-designed research scopes and methods to address research end user identified and prioritised gaps in knowledge capital and improvements to the	April 2024	Completed in reference to Uluru Kata Tjuta Living Laboratory workshop outcomes.

Responsible IP Area	Deliverables/milestones	Date completed/ Partially completed	Status & Comments
	interoperability of existing knowledge products (2 priority research scopes and methods per year)		
IP1.02.02	Detailed project RP2025 developed	August 2024	Completed
IP1.02.02	- Workshop with Traditional Owners and partners organisation(s) to discuss and plan steps towards establishment of remote areas living laboratory	October 2024	Completed and project brief established for refinement and implementation with partners in 2025.
IP2.02.01	RP4 review and planning meeting with Departmental Research Users (sub project IP2.02.01)	25 February 2024	Completed
IP2.02.01	Updated RP5 co-designed with research users, incorporating Identification and scoping of additional pilot intervention sites	30 July 2024	Completed
IP2.02.01	Fact sheet illustrating methodology for identifying locations for case studies	31 August 2024	Completed. Report and fact sheet created and uploaded on Hub's website after DCCEEW approval
IP2.02.01	A report on tyre dust and recommendations for interception pilots	31 August 2024	Completed. Report and fact sheet created and uploaded on Hub's website after DCCEEW approval
IP2.02.01	A final report on a nationally consistent monitoring system (protocol) and national database for microplastic pollution	30 October 2024	Completed. Covered in Report and uploaded on Hub's website after DCCEEW approval
IP2.02.01	A plan for interception pilot for synthetic grass	30 November 2024	Completed. Report and factsheet created. and uploaded on Hub's website after DCCEEW approval in 2025, hence will be included in the annual outputs for 2025
IP2.02.02	Fact Sheets and other communication tools about fit for purpose technologies for different waste demographic settings	30 September 2024	Completed. Part of RP3 (milestone 4). Short report and factsheet created and uploaded on Hub's website after DCCEEW approval
IP2.02.02	RP4 review and planning meeting with Departmental Research Users (sub project IP2.02.02)	30 January 2024	Completed

Responsible IP Area	Deliverables/milestones	Date completed/ Partially completed	Status & Comments
IP2.02.02	Demonstration of case study 2 - Remote Community Project Progress Report	30 July 2024	Completed. Report created and uploaded on Hub's website after DCCEEW approval in 2025, hence will be included in the annual outputs for 2025
IP2.02.02	Annual Technology forecast for evaluated technologies	30 September 2024	Report created and uploaded on Hub's website after DCCEEW approval
IP3.02.01	Progress report for IP3.02.01 for RP2023	30 April 2024	Completed
IP3.02.01	Critical review of ecotoxicology methodologies for CoPCs.	30 April 2024	Completed on time. First version completed by April 30, 2024. Feedback received on 15 May 2024. New version submitted to research users on 15 November 2024. Feedback received and finalised on 28 November 2024
IP3.02.01	Methodology framework for preliminary ecotoxicology assessments.	30 April 2024	Completed on time. First version completed by April 30, 2024. Feedback received from Research users on 15 May 2024. New version submitted to research users on 15 November 2024. Feedback received and finalised on 28 November 2024
IP3.02.01	Draft priorities for next research plan (RP2025)	30 June 2024	Completed.
IP4.02.01	Progress report for RP2023	1 March 2024	Completed
IP4.02.01	A document detailing a Roadmap forward for further conversations and if appropriate, the development of project ideas to carry out in further years of this project. Summaries of any meetings and workshops throughout RP2023 will be provided.	15 May 2024	The road map was completed with support from the Hub communications team. The map is now available on the Hub website.
IP4.02.02	Acquire CCAM downscaled data ensemble package for 2050	15 March 2024	Completed. Now being integrated into the models.
IP4.02.02	Progress report for RP2023	15 March 2024	Completed

Responsible IP Area	Deliverables/milestones	Date completed/ Partially completed	Status & Comments
IP4.02.03	**Base case (2013-2017) runs** Run 4 x 5 year base case models	30 June 2024	Completed
IP4.02.02	***2048-2052 future climate runs*** Decide on 2 most important anthropogenic emissions scenarios to run, in consultation with stakeholders.	31 August 2024	In progress. Delayed until first 8 x 5 year 'climate only' runs were completed.
IP4.02.02	Commence running 8 x 5 year models for each scenario.	1 September 2024	In progress. First scenario run and analysed.
IP4.02.03	Pre-intervention data captured	From 1 April 2023 to 31 December 2023	Low-cost air quality monitoring commenced in Launceston, TAS, Snug, TAS and Canberra, ACT. A comprehensive network of monitors already exists in Armidale, NSW and Mt Barker, SA.
IP4.02.04	HEPA comparison and intervention study report	Partially completed (1 November 2023)	Intervention study was completed and published. Comparison work in draft form and provided in Milestone 2 report; Stakeholder approval received. DCCEEW approval pending. Results are included in milestone 3 report
IP4.02.04	HEPA decision tool report and plain English guidance pieces report	1 November 2024	Approved by research users and DCCEEW approval pending.
IP5.04.01	Workshop with the Department to discuss and agree the focus of the Australian Material Flow, Waste and Circularity Report	30/09/2024	Completed. The RP4 research program is fully aligned with DCCEE priorities.
IP5.02.02	Report on best practice case studies (from other Australian states/territories or overseas) of tyre and/or conveyor belt recycling that could provide learnings for implementation in WA	May 2024	Completed. Report and Factsheet uploaded on the Hub's website after DCCEEW approval. All of project IP5.02.02 outputs have informed the National End-of-Life Tyres Options Project Discussion paper prepared by DWER
IP5.02.02	Presentation of research findings at a conference, workshop or webinar and presentations tailored for government and industry audience	June-September 2024	Completed. Stakeholder presentation to showcase tyre circularity report, Webinar, 25 July 2024

Responsible IP Area	Deliverables/milestones	Date completed/ Partially completed	Status & Comments
			Presentation in panel discussion to showcase the work, 29 July 2024 Abstract and poster presentation at Circular Economy for Climate and Environment (CECE) conference, Sydney, Australia 30 September to 2 October 2024 Abstract and oral presentation at Waste & Resource Recovery Conference, Perth, Australia 2024 4-5 September 2024
IP5.02.02	Final Project findings will be disseminated to all relevant stakeholders and publicly available on the NESP2 SC&W Hub Website	June 2024	Completed
IP5.02.03	Publication of three regional LGA in depth case studies	November 2023- Delayed to March 2024-Partially completed	Due to Prof. Lane's retirement, this publication has been delayed to May 2025
IP5.02.03	Share results and launch online regional and remote LGA community (if additional funding secured, dashboard development then launch, recruit facilitator)	March 2024- moved to October 2024 as per RP2025- partially completed	Results shared in multiple DCCEEW presentations. ACE hub engagement pending due to change in organisation and resourcing, but will be picked up in 2025
IP5.02.03	Report - Generate socio-technical profile, research design and recruit trial participants	June 2024- moved to December 2024 as per RP2025-partially completed	With pivot to modified research questions (RO2025), criteria and database developed. Recruitment will take place as part of detailed interviewing on selected case studies over 2025.
IP5.02.04	Short summaries of outcomes of each yearning circle	May 2024	Completed. Interim report created for Internal use and final report due in 2025.
IP5.02.04	Yarning circles (group discussion) on the identified waste management issues and presentation of research outcomes with the relevant community members will be conducted to seek feedback and suggestions.	May 2024	Completed. Interim report created for Internal use and final report due in 2025.

Responsible IP Area	Deliverables/milestones	Date completed/ Partially completed	Status & Comments
IP5.02.04	Yarning circles on waste management priorities and possible circular economy solutions	September 2024-moved to Feb 2025 as per RP2025	Completed yarning sessions with business. all research activities related to Indigenous communities and businesses requires extended time to complete required tasks following Indigenous research protocols.

Cross-cutting initiatives

We adopted an Initiative champion strategy to make sure all cross-hub activities were progressing. In this model, different researchers and IP leaders leading a cross-hub collaboration coordinate the activities under the guidance of Hub Leader, Professor Veena Sahajwalla.

Various key cross-hub activities and internal SCaW Hub cross collaboration progressed this year, with a focus on ensuring synergies and alignment between IP areas:

- IP1.02.01- In 2024, Several meetings happened with our research partners the Melaythenner Teeackana Warrana Aboriginal Corporation (MTWAC) to shape up this cross-Hub collaborative, Indigenous-led research. This project also received additional funding to expand this research into understanding climate impacts on wellbeing and opportunities for climate adaptation. The research will begin in earnest in 2025, once the ethics has been fully approved.
- IP1.02.02- A cross-cutting initiative between the two research streams has been in the establishment of a scoping panel for the development of First Nations research advisory body consistent with NESPs 3 category approach. This body will ensure First Nations engagement and leadership in all IP1.02 research programs and outputs.
- IP2.02.01 has continued to develop a cross-cutting initiative with the Marine and Coastal (MAC) Hub to investigate the impact of microplastics. The IP2 researchers are bringing their expertise on analysis and identification of microplastics, while MAC Hub researchers are collecting samples and providing understanding on the toxicological impact of microplastics. In 2024, the IP2 team has received samples that have been in the marine environment for different durations and started analysis to demonstrate the degradation mechanisms over time. We will work with the MAC Hub to connect these degradation mechanisms in the marine environment and their effect on the production of microplastics, and how this will impact marine ecosystems. .
- End of life tyres, recycled rubber, and products with recycled rubber content remain a priority focus for IP3 remains. Given that tyres are also a focus in both IP2 and IP5, discussions related to the amalgamation of the tyre research story at the SCaW Hub level have continued. Further coordination of the stakeholder engagement and research outcomes is continuing.
- IP4.02.02 continued engagement with the climate adaptation cross-cutting program of the Climate Systems Hub. Datasets have been shared.
- IP5.04.01- There are potential linkages across NESP Hubs that have not yet been explored.

- IP5.02.03: Where the database of regional initiatives overlaps with cross-hub activities, we will prioritise including them for more detailed analysis and description (pending agreement from project leads and SCaW hub).
- IP5.02.04 project focuses on identifying nationally representative Indigenous communities in Western Australia, understanding their waste issues, and creating circular economy business opportunities through co-design and Indigenous leadership. The project's cross-cutting mission is to explore possible capacity development opportunities while exploring possible circular economy business opportunities in regional and remote areas.

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

Each year, specific emerging priorities may be identified by the Department, hubs or third parties for delivery as research projects. If endorsed by the Department, a hub will develop research project/s to address the emerging priority.

Hubs are flexible and adaptable to respond to emerging priorities, with the ability to rapidly scale output, bring in external expertise or respond if additional resources are made available. Hubs are required to set aside 10% of NESP funding being spent per calendar year (in any category) so they can respond to emerging priorities; these funds can be rolled into the subsequent year if they are not used. Emerging priority projects are developed outside a hub's annual research proposal process. Once emerging priority projects have been approved, a hub's research plan and activity budget for the relevant calendar year will be amended, and emerging priorities will be included in the hub's annual progress reports.

In 2024, an emerging priority project "Developing a real-world testing protocol for evaluating particulate and greenhouse gas emissions from Australian wood heaters" has commenced. Since the contract for this EP project executed late, there was delay in the start of this project and commenced in September 2024. Variation in timelines of this project have been approved by the department. The aim of the project is to develop a revised testing protocol that reflects every-day use in the Australian community. Incorporation of the new protocol into Australian standards for wood heaters will enable and incentivise the sale of appliances that are considerably less polluting that those certified to current standards and provide major health and environmental benefits. The team has employed and trained a technical officer. As a co-contribution the university has also funded a PhD scholarship to support the work. The EP project team has commenced testing a range of appliances using operational procedures intended to reflect real-world usage. In March/April 2025 review the data from the first round of testing and define a draft protocol will happen and then proceed to further testing and refining of the protocol to ensure it can be consistently implemented on a wide range of Australian heater designs. Other Emerging Priority project "Remanufacturing Plant and Plastic Wastes in Regional and Remote Communities" was not commenced in 2024 and moved to 2025 due to delay in the contract execution between Firesticks and UNSW. The Hub will submit the variation in timelines of this project to the department once the contract is executed.

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 (Signing of Agreement by the Department) to 17 (Acceptance of final Research Plan 2025 by the Department).

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 fourth year, the focus was on mobilising teams, ramping up research, and continuing the collaboration with project partners and research-users. Outputs were delivered in line with the Research Plans for 2022, 2023 and 2024. Outcomes for 2024 focused on delivering best-practice research to deliver practical solutions and impacts. As the research progresses over the next three 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)

IP1.02.01 Nature Connection

In 2024 this project completed several knowledge products and had impactful outcomes across our three research streams:

Stream 1: Nature Connection (Survey/Storytelling)

In 2024, we had several outputs for the Nature Connection Stream:

- A National Survey on Nature Connection: Infographic Report
- Measuring, understanding and enhancing nature connection: a short report
- Nature Connection and Wellbeing in Australia: a short report
- The Nature Connection Storytelling Project: Connecting all Australians to Nature

We were asked to present for the DCCEEW-wide ‘spotlight on science’ seminar series in November with approximately 80 interested research users wanting to know more about how nature connection relates to wellbeing and pro-environmental behaviours.

Findings were also presented at four national conferences: Australian Institute for Family Studies, Outdoor Health Australia, Healthy Environments and Lives Conference and Ecological Society of Australia.

We submitted three academic papers (two from the survey one from HDR research on nature connection in wetlands), the revisions for which we are currently working on. We have several more academic papers drafted, preparing to submit in 2025 and a tool for assessing the nature connection opportunities at wetlands.

In the Storytelling project, we collected and released >100 stories about nature connection from diverse populations within and beyond Tasmania and released a report to share the framework and methods of the Storytelling Project.

Stream 2: Nature-based solutions & greening

- In 2024, we released the Inclusive urban greening report which was done in collaboration with the City of Launceston and formed the foundation for their urban greening strategy. High-resolution spatial data on urban heat and canopy cover, and socio-economic data was combined with focus group qualitative data to create recommendations for inclusive and equitable urban greening. As a result of the research, the urban greening strategy for Launceston strategy is the first in the nation to take a data-driven approach to equitable urban greening. This work received a Planning Research Award for Tasmania and in in the running for the national Planning Research award.

Stream 3: Indigenous-led research

Our main outputs from this work in 2024 were the signed research contract and the submitted ethics application.

IP1.02.02 Water Sensitive and Liveable Communities

Stream 1 outputs for 2024 were to develop communicative outputs following a number of workshops with regional and remote community stakeholders, nationally. This has included a report on the local government areas survey which details regional and remote LGA water servicing needs, and communication materials presenting next steps following of a series of co-design workshops for the development of a national capability building platform. These outputs will be used to foster ongoing engagement for the formulation of a steering group to oversee next steps in platform design. A second major output has been in the establishment of a strategic direction plan with on ground partners at Uluru Kata Tjuta National Park in the first of a series of remote and regional areas living laboratories.

Stream 2- Aqua nullius, has continued engagement with indigenous water practitioners to establish the network an insight for a national water camp for 2025 that will aim to bring together First Nations water practitioners and allies for yarns about the future of Australia's water governance framework, requirements for reinvigorating First Nations water knowledge and science. A report providing an overview of key outcomes of one of these workshops was developed to inform and end-users and support continued engagement.

A cross-cutting initiative between the two research streams has been in the establishment of a scoping panel for the development of First Nations research advisory body consistent with NESPs 3 category

approach. This body will ensure First Nations engagement and leadership in all IP1.02 research programs and outputs.

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

IP2.02.01: Understanding Microplastics

In 2024, the project delivered key research outputs that strengthened efforts to monitor and mitigate microplastic pollution. The project focused on high-risk sources, including tyre and road wear particles and synthetic grass.

A methodology report was developed to identify optimal locations for impactful microplastic case studies. Additionally, a factsheet on site selection for microplastic sampling was produced to assist researchers in implementing best-practice monitoring strategies. These outputs contributed to the refinement of a microplastic monitoring protocol, enhancing IP2's ability investigate microplastic pollution.

The Hub Researcher is helping to set the standard for microplastics research with the release of the new Australian Standard AS ISO 24187: Principles for the analysis of microplastics present in the environment. This milestone, achieved through contributions from experts like Dr Rumana Hossain, will benefit researchers, government agencies, and industries in understanding and reducing microplastic pollution.

Further research examined tyre and road wear particles, culminating in a detailed report on sources, sinks, and mitigation strategies. This report, supported by collaborations with Ocean Protect and Sea Shepherd, provided insights into the movement of microplastics through urban stormwater systems. A complementary factsheet was released to communicate findings and recommendations to stakeholders.

As part of IP2.02.01, the team participated in the Rubbish on The Shore (ROTS) – Ghost Net Think Tank at Gulkula, on Gumtaj Clan Country. The event, held with Indigenous Rangers, DAFF, Parks Australia, and Agency Projects, explored the impacts of ghost nets and microplastics on Sea Country. Discussions highlighted Indigenous-led monitoring and management approaches, reinforcing the importance of on-ground collaboration. IP2's research on microplastic sources and degradation benefited from these insights, strengthening efforts to develop effective strategies for debris mitigation through policy, partnerships, and community-driven solutions.

Demonstration activities have been critical in validating site-specific microplastic mitigation technologies. Pilots involving stormwater filtration systems and collaborative field testing with stakeholders such as Sea Shepherd and Ocean Protect not only provided empirical performance data but also yielded transferable lessons. These pilots and understanding of microplastics characterisation techniques (at UNSW Sydney) directly supported the development of a nationally consistent microplastics monitoring protocol and contributed to the new Australian Standard AS ISO 24187 (first ever national standard in Australia specifically addressing microplastics). Such outcomes exemplify how localised trials and laboratory characterisation techniques can inform national-scale frameworks. Additionally, Indigenous-led monitoring at the Rubbish on the Shore Ghost Net Think Tank demonstrated the value of integrating Traditional Knowledge into contemporary scientific practices.

The event reinforced the importance of collaborative, on-ground engagement to develop effective monitoring strategies and policy interventions that support both environmental and community-led solutions for plastic waste.

This project also worked on a comprehensive review of existing Australian research on microplastics in various environments (published in the journal, Case studies in Chemical and Environmental Engineering), such as sediments, indoor air, road dust, fresh water, marine water, and living organisms. The research summarised microplastics characteristics, sources, and impacts on humans and ecosystems, highlighting the lack of specific microplastic legislation and making policy recommendations to address microplastic pollution.

Outcomes:

- Provided a comprehensive overview of microplastics in Australia.
- Highlighted the significant environmental and health risks posed by microplastics.
- Emphasised the need for further research on microplastics' generation, migration, and risks.

Outputs:

- Supported the creation of policies to regulate plastic waste and microplastics in consumer products.
- Advocated for targeted legislation to protect environment.
- Recommended replacing microbeads in consumer products with safer alternatives and addressing "greenwashing" in plastic waste management solutions.

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

In 2024, IP2.02.02 advanced its efforts in **identifying and evaluating recycling technologies** suited to regional and remote communities. A key focus was on refining **a technology road map** that detailed current and emerging waste processing technologies, helping to define practical solutions for diverse waste streams.

A series of factsheets were created, incorporating data from the Australian and Bureau of Statistics, to explain the various indexes used to categorise remoteness in Australia, particularly the **Australian Statistical Geography Standard (ASGS)**. In the interest of consistency, and to provide clarity to research users, this standard was chosen to define **remoteness** across all IP2 outputs. The defined categories provided an improved structure for framing the case studies. This research helped stakeholders **translate the lessons** offered by these case studies to their context, providing a **foundation for making better informed decisions** in the **selection of suitable-scale, technological recycling initiatives** further detailed in the Annual Technology Forecast.

To ensure practical and region-specific solutions, **two workshops were conducted at regional conferences**, engaging local stakeholders in co-designing a circular technology framework. These

workshops facilitated collaboration between industry, local councils, and Indigenous communities, shaping strategies for **scalable and economically viable recycling solutions**.

Additionally, an internal dashboard was developed to summarise key findings on **waste management infrastructure gaps** and potential interventions tailored for remote areas, progressing towards a portal.

The project continues to investigate **sustainable circular economy technologies**, to enable regional and remote communities to have access to fit-for-purpose recycling technologies.

The project also addressed the challenges faced by regional and remote communities in adopting sustainable practices, promoting circular economy principles through outreach activities and practical solutions.

Outcomes:

- Promoted partnerships and collaboration to raise awareness about circular economy principles.
- Provided practical solutions and frameworks for transitioning from linear to circular systems.
- Highlighted the significant environmental and health risks posed by microplastics.

Outputs:

- Delivered impactful outreach events, including the Resources Energy and Industry Innovation Forum (REIIF), Forbes Shire Council's Circular Economy Workshop, and the Orana Youth Forum.
- Developed a comprehensive review of current and emerging technologies for circular economies in regional and remote communities.

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

IP3.02.01: Quantifying mass and potential release of chemicals of potential concern in our wastes and recovered resources

Building on the sampling guidance and leaching methodology prepared in 2023, a framework for preliminary ecotoxicology assessments was co-designed in 2024. The combination of these guidance and methodology materials is envisaged to form the foundation of a national chemical risk assessment toolbox.

Leaching methods were modified for use under passive conditions, based on literature and data reviews and feedback from research users. This will enable meaningful ecotoxicology assessments to be completed in RP2025.

Relatedly, continued liaison with industry stakeholders has allowed the research to extend to products containing recycled rubber content. Industry supplied samples enabled the development of a new leaching method that can be used alongside standard leaching assessments to generate meaningful chemical availability assessments from products with complex chemical mixtures. A publication on method development will be submitted for publication shortly.

A mid-project data review enabled identification of priority gaps and target chemicals and samples for further characterisation, availability and potential ecotoxicology assessments in relation to recycled rubber from end-of-life tyres and electronic wastes. As a result, the sample cohort for investigations has been increased to decrease the impact of variability and improve the quality of data generated by

the project, and targeted re-investigation for chemicals of potential concern (including persistent organic pollutants) has been undertaken.

Research findings were communicated via conference presentation at the September CleanUp Conference in Adelaide, 2024.

A paper summarising the priorities for Australian waste management research was prepared and submitted to Scientific Reports and is currently under review.

A paper describing the development of a new method for the assessment of the availability of chemicals of concern from products with recycled rubber content was prepared and submitted to Journal of Environmental Management and is currently under review.

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: Let's yarn about smoke

- The CSIRO IRG was successful, and this has enabled us to conduct yarning circles with Indigenous communities as well as support an Indigenous research fellow and two Indigenous research officers.
- A national map of relevant Indigenous research activities related to air quality and Indigenous health was created with input from the Key Thinker's Forum.
- A draft manuscript has been written summarising the KTF process with plans to submit to the Lowitja Institute.
- A presentation was made at the HEAL annual online conference.

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

Research article "Quantifying natural emissions and their impacts on air quality in a 2050s Australia was submitted in 2024 to the journal of Atmospheric Environment and accepted in 2025

Following presentations were delivered in 2024:

- Invited talk at Gordon Research Conference on biogenic hydrocarbons and the atmosphere, Barcelona Spain, June 13th, 2024.
- ACCOMC meeting. "Meteorological drivers of air quality in 2050: ventilation, washout and natural emissions", Aspendale. November 14th,2024.

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

A presentation was made at the HEAL annual online conference.

A presentation was made to the interjurisdictional community of practice (COP) on wood heaters, chaired by NSW DCCEEW

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

A commentary paper 'Community cleaner air spaces during landscape fire events: What do we know?' to Australian and New Zealand was prepared and accepted in Journal of Public Health.

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

Project IP5.04.01: Metrics, data and indicators for material flow and stocks, waste and emissions to monitor progress of Australia's circular economy transition

CSIRO has contributed to the development of the National Circular Economy Framework by informing its measurement and metrics. The CSIRO team developed comprehensive material flow accounts for Australia and proposed three new circularity metrics (the circularity rate, material footprint, and material productivity) which were presented to the Ministerial Advisory Group for the Circular Economy and subsequently adopted for the national framework. Drawing on modelling conducted for the UNEP International Resource Panel, the CSIRO team explored a circular economy policy scenario and proposed ambitious and yet achievable targets for these metrics.

For the first time, CSIRO has contributed to establishing national targets for Australia's circularity rate, material footprint, and material productivity. These targets have now defined the national ambition: to double Australia's circularity rate, reduce the per-capita material footprint, and improve material productivity. CSIRO also collaborated with State and Territory governments, many of which seek to measure their circularity performance and depend on CSIRO's work under the SCaW Hub to provide the necessary evidence base. There is growing interest at the local council and regional levels in assessing a circular economy baseline to identify opportunities and gaps.

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Outputs

- Data delivery for the circular economy metrics of the Treasury's Measuring What Matters framework. Times series for Australia's circularity rate, material footprint and material productivity 2010- 2023.
- Workshop with the Circular Economy Policy team to agree on the key objectives and outputs of this phase of the project.
- Meetings with State government agencies in Victoria, South Australia and Queensland to discuss State based material flow accounts and circularity metrics.
- Meeting with Western Australian government agency to provide feedback on their material flow assessment that was prepared by Curtin University.

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

CSIRO and Curtin University have reviewed international best practice case studies to inform policy and technology development for end-of-life tyres and conveyor belts in Australia.
There is growing interest in the state and federal government to find policy solutions to increase value recovery from end-of-life tyres, including off-the-road tyres and conveyor belts.
The Department of Water and Environmental Regulation of WA has led a national collaborative project on options for end-of-life tyres to establish a collective understanding of the problems associated with EOLTs, including for off-the-road (OTR) tyres, and included consideration for

conveyor belts and rubber tracks (related products). The discussion paper of the DWER project that was sent for stakeholder consultation has cited the NESP Hub project reports and is well aligned with the recommendations presented in the NESP Hub project reports.

Outputs:

- A report and industry snapshot on Exploring opportunities for increasing value recovery from end-of-life tyres and conveyor belts in Western Australia, Boxall NJ, Tobin S, Minunno R, Cheng KY, Zaman A, Kaksonen AH. (2023) was published on SCaW Hub website in 2023.
- A report and industry snapshot on Best practice case studies for increasing value recovery from end-of-life tyres and conveyor belts, Anna H Kaksonen, Benjamin Gazeau, Ana María Cáceres Ruiz, Ka Yu Cheng, Roberto Minunno, Steven Tobin, Atiq Zaman, Naomi Boxall. (2024) was published on SCaW Hub website in 2024.
- Webinar presentation for stakeholders 25 July 2024 and a short presentation as part of a panel discussion 29 July 2024.
- Boxall, Naomi, Tobin, Steven, Minunno, Roberto, Cheng, Ka Yu, Gazeau, Benjamin, Caceres Ruiz, Ana Maria, Zaman, Atiq and Kaksonen, Anna (2024) Exploring opportunities for value recovery from tyres and conveyor belts in WA. Waste & Resource Recovery Conference 2024. 4-5 September 2024. Abstract and oral presentation by Naomi Boxall.
- Kaksonen AH, Gazeau B, Caceres Ruiz AM, Cheng KY, Minunno R, Zaman A, Boxall NJ (2024) Best practice case studies for increasing value recovery from end-of-life tyres and conveyor belts. Abstract for Circular Economy for Climate and Environment (CECE) conference, Sydney, Australia 30 September to 2 October 2024. Abstract and poster presentation by Ana Maria Caceres Ruiz

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

Outcomes:

- Informed DCCEEW's preparation for the Place Based theme of CEMAG in August with research results, supporting evidence-based policy option formulation for national CE framework
- Shared results and project plans with EU Circular Regions initiative in Oslo, Norway, (during unrelated conference travel). Nascent collaboration means our regional database development integrate with an emerging EU initiative of a similar nature, building relationships for international collaboration and impact.
- PhD Student Natalia De Miranda Grilli (UTAS) engaging with plastic governance treaty in Korea, informed by the project, as part of her PhD, and developing a chapter for her thesis based on it. This demonstrates supporting early career research development.
- Contributed to options report for Shepparton Regional CE initiative, and built relationships for RP2025
- Survey results shared with state and local government bodies, elevating awareness about challenges in regional and remote Australia

Outputs

- Reporting included a presentation with the DCCEEW CE Branch seminar series in February, which led to an invitation to discuss the work with the CEMAG secretariat team in July.
- Updated report on national survey – with a greater focus on policy intervention arguments and implications for support place base initiatives.
- Analysis of waste contribution by LGA to assist with prioritising areas for intervention.
- Development of criteria and initial database of regional and remote initiatives to support the work of 2025-2026.
- Engagement with ACE Hub of regional and remote local government has not progressed as planned, we understand due to limited capacity and organisational changes, however we anticipate picking this up as part of 2025 activities.

Project IP5.02.04: Identifying opportunities from waste management and resource recovery and the circular economy for Indigenous communities and businesses)

Outcomes:

- Enhanced Indigenous Engagement and Leadership – The project fosters Indigenous self-determination by actively involving Elders, community representatives, and young Indigenous participants in shaping circular economy solutions.
- Better understanding on the Community-Led Waste Management Initiatives – The discussions and field visits provide a deeper understanding of waste littering challenges in regional bushlands, informing community-driven strategies for waste reduction.
- Integration of Youth Perspectives – The engagement of young Indigenous participants ensures that intergenerational knowledge and future leadership are embedded in sustainable waste management practices.
- Identification of Business and Economic Opportunities – The project explores Indigenous-led circular economy business models, creating pathways for economic development and employment within Indigenous communities.
- Capacity Building and Knowledge Sharing – The findings from the yarning circles contribute to policy discussions, community education, and industry collaboration on sustainable waste management.

Outputs:

- Five Yarning Circle Sessions and two Youth Yarning Sessions – Documenting key challenges, insights, and solutions shared by Whadjuk Noongar Elders and community representatives as well as youth.
- 2 Field Visits – Highlighting firsthand observations and challenges related to waste littering in regional bushlands.
- Preliminary Findings Report – Presented to the SC&W Hub Steering Committee and end-user stakeholders, summarising key insights from Milestone 2 discussions.
- Draft Interim Report – Shared with end-users for feedback, refining project direction based on community and industry input.
- Final Report (May 2025) – A comprehensive analysis of findings from community yarning circles, youth engagement, and Indigenous business discussions, informing future waste management and circular economy initiatives.

Short- to medium-term outcomes – quantitative measures

Table A: Quantitative performance measures (short- to medium-term outcomes) Note: For the third year of NESP2 hubs, the reporting period is 1 January 2024 to 31 December 2024. Unless specified otherwise, the term 'Research-user' refers to Departmental and/or external users.

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	# co-designed projects / # total projects a) Hub 10 /13 IP1- 2/2 IP2- 2/2 IP3- 1/1 IP4- 4/4 IP5- 4/4 EP-01/01 # projects with research delivery / # total projects b) Hub -11/13 IP1- 2/2 IP2- 1/2	**Sub Point a)** **IP1-** There are three main projects underway in **IP1.02.01**: Nature connection, Nature based solutions and urban greening, and Indigenous-led research. All of these have been co-designed with DCCEEW research users, achieving research delivery and are impacting policy and practice. There are 2 major projects currently underway as part of the two **IP.02.02** projects stream, comprising both place-based/Country-centred programs and nationally focussed initiatives. All of these are co-designed with end users, ensure their engagement throughout and support use/uptake of research outputs. **IP3** – Has one ongoing project and DCCEEW is the primary research user for this project. The research plan for RP3/4 was co-designed with our research users at DCCEEW. Findings, data and information are routinely communicated, and input provided by research users to ensure the continuity and relevance of research undertaken in IP3. Our

No.	Performance measure	Result for reporting period (numerical only)	Explanation, if any
		IP3- 1/1 IP4- 3/4 IP5- 4/4 EP-0/01 # projects achieving end use / # total projects c) Hub 9/13 IP1- 2/2 IP2- 1/2 IP3- 1/1 IP4- 1/4 IP5- 4/4 EP-0/01	research users are critical for delivery of IP3 research to their internal and external stakeholders. The sampling guidance prepared by IP3 is being circulated for feedback with our research users and their internal and external stakeholders. The sampling guidance is expected to be used when planning sampling events for other complex waste materials not otherwise investigated through IP3 (e.g., biosolids, organic waste). A codesign process was used to develop the tiered ecotoxicology approach that is being used to guide the development of tiered assessment of chemical effects. The process involved input and feedback from DCCEEW, NSW EPA, Vic EPA, Ecological Services Australia and National Measurement Institute. A separate project was also initiated and completed with Sustainability Victoria (SV) examining the leachability of chemicals of concern from rubber reuse products (i.e. second life products). **IP4- C**o-design of project IP4.02.01 continues to engage and interact with relevant Indigenous researchers and organisations through regular workshops (twice yearly) and through established newsletters circulated by the HEAL network. The smoke messaging project includes two externally funded grants - the MRFF funded project being led by Charles Darwin University which is co-designing a citizen science project on air quality in remote communities with the Miwatj Health Centre and - an Asthma Australia funded project translating current

No.	Performance measure	Result for reporting period (numerical only)	Explanation, if any
			scientific evidence and findings from consumer group engagement into a suite of advice materials tailored for use by people of Aboriginal, and Arabic backgrounds, health professionals and policy makers to take practical actions to reduce exposure to air pollution. This has included communities in NSW and ACT that were impacted by the 2019/20 bushfires. IP4.02.03 collaborating with local government to evaluate different interventions to reduce reliance upon wood heaters. IP4.02.02 is a cross hub collaboration. IP4.02.04 the UNSW and CSIRO team members are leading this work. Engagement with relevant state stakeholders is planned. **Sub Point b)** **IP2** – The use and research uptake of the Regional and Remote project is yet to be realised. Once the forecast and dashboard has been released, we hope to see further uptake of the findings. **IP4-** IP4.02.02 has generated a peer-reviewed manuscript that was submitted to a journal at the end of 2024, revisions have also been submitted so anticipate a response in the near future. IP4.02.01 has generated an interactive map of Indigenous research activities related to air quality and

No.	Performance measure	Result for reporting period (numerical only)	Explanation, if any
			Indigenous health along with a video interviewing key attendees of the Key Thinker's Forum. **Sub Point c)** **IP4-** IP4.02.04 has generated FAQs for the web-based selection tool for portable air cleaners.
2	Research outputs in the reporting period provided to research-users on time and as identified in the approved research plans: a) total number b) proportion	Total Number a) Hub – 30 IP1- 7 IP2- 10 IP3- 1 IP4- 4 IP5- 8 # outputs delivered on time/overall RP2024 expectation b) Hub -28/36 IP1- 5/8 IP2- 10/13 IP3- 4/4 IP4- 7/9	**Sub Point a)** **IP1** – During the reporting period, IP1.02.01 delivered 5 research products in 2024. These were delivered on time and according to co-design principles. **Sub Point b)** **IP1-** For IP1.02.02- 3 research outputs have been delivered for 2024, however these experienced a number of delays resulting from review periods and end user input and as such we finalised after the proposed timeframe in research plans **IP2**- All outputs were delivered 3 months within the expected date. some outputs received the DCCEEW approval in March 2025 and hence will be reported in 2025 APR **IP3** –All milestones were delivered as planned **IP4** – All four projects delivered the RP2024 milestones plus additional outputs. These met the KPI. Not all reporting outputs have been through the full approval process yet.

No.	Performance measure	Result for reporting period (numerical only)	Explanation, if any
		IP5- 2/2	Emerging project(- EP)- An emerging priority project "Developing a real-world testing protocol for evaluating particulate and greenhouse gas emissions from Australian wood heaters" has commenced in 2024. Since the contract for this EP project executed late, there was delay in the start of this project and commenced in September 2024
3	Proportion of completed research projects that are confirmed to meet the needs of departmental research-users as identified at project co-design stage	# completed projects meeting DCCEEW end-user needs / overall completed research projects IP5- 01/01	.**IP5** – IP5.02.02 completed in 2024.
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 -2 IP1- 2 IP2- 0 IP3- 0 IP4- 0 IP5- 0 EP-0 b) Hub -6 IP1- 2	**Sub Point a)** **IP1-** Both IP1 projects have sub-projects/research streams that are Indigenous-led and co-designed to meet the management priorities of Indigenous stakeholders. **Sub Point b)** **IP2** – IP2.02.01 has engaged with Robert Markham, Indigenous facilitator, and Firesticks to understand their priorities. The project also engage with Agency Projects to meet the research and management priorities of Indigenous Ranger Groups.

No.	Performance measure	Result for reporting period (numerical only)	Explanation, if any
		IP2- 1 IP3- only indirectly IP4- 1 IP5- 1 c) Hub -2 IP1- 2 IP2- 0 IP3- 0 IP4- 0 IP5- 0	**IP3** – The project has a heavy chemical analytical and laboratory-based technical schedule. We consider research and management priorities of Indigenous stakeholders as they arise in Hub meetings. **IP4** – IP4.02.01 was successful in obtaining a CSIRO Indigenous Research Grant. This was co-designed and supports an Indigenous post-doctoral fellow and two Indigenous research officers.
5	Number of peer-reviewed, NESP-funded publications during the reporting period	02 (accepted/published in 2024 only)	**IP1**- IP1.02.01 – four articles were submitted for peer-review in 2024. These are expected to be through the peer-review process and published in 2025. IP1.02.02- one peer reviewed publication has been finalised and submitted for consideration to UAA Journal, we are awaiting reviewer comments. Reporting may be in 2025 once accepted/published. **IP2** – IP2.02.01 published two peer-reviewed manuscripts **IP3-** Two manuscripts have been prepared. One in draft (leaching methodology), and one approved for submission and in review (waste research priorities, Scientific Reports and the other in Journal of

No.	Performance measure	Result for reporting period (numerical only)	Explanation, if any
			Environmental Management. Reporting may be in 2025 once accepted/published **IP4** - IP4.02.02 and IP4.02.04 submitted manuscripts in 2024 but published in early 2025 hence reporting will be in 2025
6	Number of NESP research citations in other researchers' publications during the reporting period	0	IP3- Early output focus has been on guidance documents that are difficult to track citation and measure impact. As noted, two manuscripts have now been prepared for peer-review publication, hopefully leading to direct citation in future years.
7	Number of completed NESP products, research publications, datasets and metadata that are discoverable and accessible in accordance with *NESP data and information guidelines* and the funding agreement	30	IP1 – All of the knowledge products produced in 2024 are open access and publicly available. Our survey data is not made publicly available as per our ethics application, but the reports and results will be. **IP2** - All research outputs are available on the Hub website. **IP3** – **04** Presentations; **01 Report** in partnership with SV that is currently commercial-in-confidence, but the findings will be included in a peer reviewed manuscript planned for publication in 2025. **01** Guidance document for preliminary tiered ecotoxicology assessment and methodology framework has been prepared and received feedback from DCCEEW research users Manuscript-- A review article submitted to Scientific Reports and is in peer review. A method paper has been submitted to Journal of Environmental Management and is in peer review.

No.	Performance measure	Result for reporting period (numerical only)	Explanation, if any
			Details for above products are included in Attachment A. In addition, the data generated in IP3 is captured in a working reporting template that is shared between IP3 and key research users at DCCEEW. This data workbook is a live document and will be submitted to an appropriate data repository at the completion of IP3 project work. **IP4** –Not all have been published yet. Some of the presentations are not suitable for public access yet as they contain research that will be published.
8	a) The number of datasets and management tools produced by hub research and made public. b) The number of other datasets and management tools that benefited from hub research and outcomes. 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.	a) 1 b) 5	**Sub point a) IP1-** IP1.02.01 – the Nature Connection Storytelling Project: Connecting all Australians with Nature report is a tool that other organisations can use to set up their own community-based nature connection storytelling initiative. **Sub point b)** **IP1-** IP1.02.02- Aqua nullius workshops have supported a workshop report that is publicly accessible as a management tool, and an Aqua nullius water dictionary that is available only to First Nations water practitioners and leaders within the IP!.02 network. A strategic plan to support an Anangu Kapi plan for Uluru Kata Tjuta National park has also been established from hu research outcomes but is not publicly available.

No.	Performance measure	Result for reporting period (numerical only)	Explanation, if any
			IP3-The datasets generated in this project are not publicly discoverable because the work is not yet complete. However, the data sets generated in IP3 meet data and information standards according to principles co-designed with research users and to meet Hub reporting requirements at the completion of the IP3 project. Datasets and information generated under IP3 have been used as inputs to databases that are being developed by DCCEEW. We are in communication with the Data wrangler and department research users to find the best approach for non-public research products (e.g., data sets). At the completion of the IP3 project, the data generated from chemical and ecotoxicology assessments will be accessed in an appropriate repository. **IP4 -** is focussed on developing such datasets and tools for public release throughout the life of the Hub.
9	a) Number (full-time equivalent) during the reporting period of PhD students b) post-doc and early-career researchers c) mid-career researchers d) Indigenous researchers e) individual volunteers (total) f) individual Indigenous volunteers (total) g) Indigenous sub-contractors	Hub – 23.29 FTE a) 5 b) 7.35 c) 4.17 d) 3.85 e) 0.21 f) 0.51 g) 2.2	

No.	Performance measure	Result for reporting period (numerical only)	Explanation, if any
10	Number of knowledge-sharing and communication events and activities held or shared: a) with on-ground managers (general) b) jointly with Indigenous researchers and Traditional Custodians c) that are Indigenous-led	Hub - 24 a) 11 b)8 c) 5	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 actually happening on-ground (not at a distance or in theoretical manner). **Sub Point a)** **IP1-** IP1.02.01 – we met with the Parks Australia manager of Uluru Park, Tracey Guest, and the Anangu community (Indigenous land mangers). We also have met with MTWAC who manage land in NE Tasmania. **IP1.02.02-** two workshops led by Anangu and Park Australia and two Aqua nullius workshops. In 2024. **IP2**- Rubbish on the Shore Think Tank event IP4 – IP4.02.03 is working with three government departments to co-design interventions to reduce wood heater emissions. IP4 hosted a webinar for all relevant stakeholders and research collaborators to provide an update at the mid-point of the research funding. **IP5**- IP5.02.03, presented at Circularity 2023 and involved on ground managers from local and state government, and industry, and Indigenous organisation representatives. **Sub point b)** **IP2**- Rubbish on the Shore Think Tank event

No.	Performance measure	Result for reporting period (numerical only)	Explanation, if any
			IP4 – IP4.02.03 is working with three government departments to co-design interventions to reduce wood heater emissions. IP4.02.01 hosted a Key Thinkers Forum with Indigenous collaborators. **Sub point c)** **IP2**- Rubbish on the Shore Think Tank event **IP1-** Attended an on-Country cultural awareness training with our Indigenous partners and in December, attended their cultural celebration with our Storytelling Pod to share Indigenous stories of nature.
11	Proportion of hub staff and researchers who have completed: 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	a) 48/48 b) 35 / 48 c) 35/ 48	All hub members have undertaken cultural capability training through Your Mob. 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: a) Category 1: Indigenous led b) Category 2: Co-design c) Category 3: Communicate	a) 0 /13 b) 04 / 13 c) 09 /13	**Sub point a)** Category 1: Nil **Sub point b)** Category2: IP1=02, IP4=01 IP5=01 **Sub point c)** Category 3: IP2=02, IP3= 01, IP4=03 IP5 = 03
13	Proportion of hub projects that have been developed in consultation with the hub Indigenous facilitator or the Indigenous Facilitation Network	4 / 13	Projects are in IP1, IP4 and IP5.

No.	Performance measure	Result for reporting period (numerical only)	Explanation, if any
14	Number of guidelines about best-practice that the hub has produced or co-produced in the reporting period, for: a) knowledge brokering b) Indigenous partnerships and products (including design of flagship engagement activities c) environment and climate management within the scope of the hub's research	a) 2 b) 1 c) 2	**Sub point a)** IP4.02.01 produced a video of the Key Thinker's Forum and map of Indigenous research related to air quality and Indigenous health. **Sub point b)** Hub's Senior Indigenous Facilitator involved through the Indigenous facilitation network in the development and implementation planning for the latest version of the Three Category Approach. IP1- Aqua nullius report for IP1.02.02 **Sub point c)** **IP1**- IP1.02.02- LGA survey report outlining LGA needs for water and liveability in regional and remote communities. **IP3 -** A preliminary tiered approach to determine the impacts of leachable chemicals from complex waste and repurposed materials. This framework is designed to guide the development of tier 1, 2 and 3 ecotoxicology methods provide preliminary data and information related to the effects of chemicals on Australian environmental and biodiversity endpoints. It contains novel methods and implementation that will be published first through peer review, before being translated into a general guidance document on the IP3 research page on the NESP SCaW Hub website.

Longer-term outcomes – qualitative measures

This is the fourth year of operation for the Hub and the second year where research continued to be implemented. The longer-term outcomes have been identified and are being 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 and summarised below.

For IP1.02.01, This project expected longer-term outcomes include:

Informing policy and frameworks

- We have been meeting and co-designing with the team responsible for Australia's Strategy for Nature 2019–2030 and have made new contacts with the Director of the Nature Positive Monitoring, Evaluation and Reporting and Environmental Indicators section to ensure our work can inform the Nature Positive efforts as well. We hope to build on the equitable, innovative and award winning collaboration on the urban greening strategy to influence local policies and strategies into the future.

Community benefits

- Our urban greening work and the sharing of diverse nature connection stories supports the inclusion of more diverse perspectives in environmental decision-making to enable sustainability transitions that improve liveability, sustainability, resilience, biodiversity, and health and wellbeing in our communities.

Economic Benefits

- The outputs from our nature connection survey indicate a strong positive relationship between nature connection and wellbeing. Our efforts to support nature connection therefore can have significant economic benefits from improved wellbeing of a country that engages and connects with nature.
- Improved management of green infrastructure assets by planting/maintaining greenspaces that meet the needs and preferences of the community.

Environmental Benefits

- The outputs from our nature connection survey indicate a strong positive relationship between nature connection and pro-environmental behaviours. Our efforts to support nature connection therefore can have significant environmental benefits from a country that connects with and cares for nature.

Partnerships & Collaborations

- We are working hard to maintain and develop strong positive relationships with our research users in DCCEEW and with partner organisations. We have had a lot of interest in our work from DCCEEW, as evidence by the multiple sections in DCCEEW collaborating on our research and by the invitation and high attendance at our Spotlight on Science presentation. We have deepened and extended our partnerships this past year through the process of applying for a Linkage grant to extend the work we have started under NESP.

For **IP1.02.02**, The long-term outcomes of this project are to establish the enabling conditions for a national platform that will support the capabilities of regional and remote areas water service

providers and community water leaders. It will do this by drawing on the national networks, concept design and place-based evidence base established through the NESP research program. Another long-term priority will be in the formulation of First nations approach to transformations within existing water governance regimes to enable the reinvigoration of first nations knowledge and science. It will do this through the establishment of a number of First Nations led yarns with First nations water leaders and practitioners, and First Nations allies throughout the current duration of the NESP program.

For IP2.02.01, This project continues to build long-term capability in monitoring and mitigating microplastic pollution. The development of a consistent microplastic monitoring protocol, as referenced in the 2023 Annual Report, provides a foundation for ongoing research and mitigation strategies. By refining **sampling methodologies**, the project **informs policy development and industry standards** for reducing microplastic emissions.

The research's focus on high-risk sources, such as tyre dust and synthetic grass, ensures that targeted interventions can be developed in collaboration with government, industry, and Indigenous partners. Findings from interception pilot studies contribute to understanding microplastic pathways, supporting evidence-based solutions for example in stormwater management and environmental protection.

By integrating Indigenous knowledge, industry collaboration, and policy engagement, IP2.02.01 lays the groundwork for long-term frameworks, circular economy solutions, and improved waste management practices, helping to reduce the environmental impact of microplastics in Australia.

For IP2.02.02, This project is driving long-term change by supporting the transition to scalable, region-specific recycling solutions for remote and regional communities. As referenced in the 2023 Annual Report, the project's work on waste demographics, technology assessments, and circular economy frameworks aims that future waste management systems are tailored, sustainable, and economically viable.

Through technical roadmaps and demonstration case studies, IP2.02.02 project aims to inform policy decisions and infrastructure planning, helping councils and businesses implement practical recycling solutions. The co-design of a circular technology framework with regional stakeholders enhances local engagement, ensuring solutions meet community needs.

By building a knowledge base of fit-for-purpose recycling technologies, the project strengthens regional self-sufficiency, reduces landfill reliance, and promotes circular economy integration. The research's long-term impact will be seen in improved waste processing capabilities, new business opportunities, and stronger environmental protections for remote and regional Australia.

In 2024, IP3 continued to build the foundation for waste and chemical risk assessment though the establishment of guidance documents, methodology statements, decision making frameworks, and a broader network of industry and government agencies.

In addition to the sampling guidance and leaching methodology prepared in 2023, a framework for ecotoxicology assessments has also been developed and further builds the tools available to research users to design and implement high quality assessments for chemicals in waste and products with recycled content. Currently, the tiered ecotoxicology approach framework is being used to guide practical experiments (Milestone 10 of RP2024). The approach will be translated into a general guidance document in RP2025, and is designed to contribute to a toolbox of guidance

materials that can be used to assess the presence, availability and effects of chemicals of concern (and unknowns) from complex waste materials and products with recycled content on relevant Australian environment and biodiversity endpoints. These materials are designed to be transferrable and applicable to materials that are not the core focus of the IP3 research plans, and this will be explored and validated in the remaining years of the SCaW Hub.

IP3 continues to build the foundation for a nationally consistent approach to waste and chemical risk assessment within the circular economy, though the establishment of guidance documents, methodology statements, decision making frameworks, novel method development, and engagement with a broader network of industry and government agencies.

All **IP4** projects have established key priorities and actions to support their research in later years.

For **IP4.02.01**, In the long-term, the air quality and Indigenous health studies that have been leveraged with support from the Indigenous Research Grant will provide air quality and health findings for vulnerable Indigenous populations. The projects will conduct yarning circles which will support the development of appropriate messaging and policies to protect priority populations' health from landscape smoke events. 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. This foundational work will also ensure that any future activities are co-designed with Indigenous partners.

For **IP4.02.02**, The air quality models being generated using a range of climate change scenarios will support the selection of appropriate climate change mitigation policies. By demonstrating the benefits of applying a range of climate change policies it will be possible to assess scenarios that will improve air quality. These will support the Department in selecting actions to help meet future air quality targets.

For **IP4.02.03** The team have been able to evaluate a range of interventions that will provide information on the economic and health benefits of implementing different mitigations to reduce the impacts of wood heater emissions. These are the foundations for rolling out any national policies around wood heater change out programs. Funding has been obtained to conduct a wood heater change out in Armidale, NSW. This is supported by local government and Asthma Australia. This will provide the evidence and methodology to conduct a larger scale roll out if national funding becomes available. In partnership with Mt Barker, SA local government, a behaviour change intervention has been evaluated in winter 2024. Findings will support broader application of relevant mitigation methods to reduce wood heater emissions.

For **IP4.02.04-** Results from the testing of a range of public buildings to evaluate and test their suitability as cleaner air shelters will provide local governments with survey tools which can be used to select appropriate buildings for use as clean air shelters during extreme smoke episodes.

IP5 will realise several longer-term outcomes. For **IP5.04.01** Australia's commitment to doubling its circularity rate, reducing its material footprint, and enhancing material productivity leads to a deeply embedded circular economy that minimizes resource extraction and waste generation. States, Territories, and local councils establish long-term strategies that integrate circular economy principles into their economic planning, resulting in systemic shifts toward resource efficiency and sustainability. Industry sectors across Australia fully transition to circular business models, embedding circularity into

core operations, supply chains, and product lifecycles, driving innovation and resilience. Sustained investment in circular economy initiatives fosters economic diversification, creating high-value industries and long-term employment opportunities while strengthening the comparative advantage of Australian industries and Australia's global competitiveness in sustainable practices. Over time, environmental pressures from material use and waste decline significantly, leading to measurable ecological restoration, improved biodiversity, and a regenerative economy that operates within planetary boundaries.

For IP5.02.02 Long-term reduction in stockpiling, dumping, landfilling, and onsite disposal of used tyres and conveyor belts, leading to a cleaner environment and improved resource efficiency. Establishment of a robust system for value recovery, creating economic opportunities, reducing environmental and human health risks, and fostering innovation in material reuse. Implementation of strong regulatory frameworks and market mechanisms in WA that support recycling infrastructure, encourage investment, and drive sustainable industry practices, particularly in regional areas. Integration of findings into industry, state, and national strategies, positioning WA and Australia as leaders in sustainable tyre and conveyor belt management, setting global best practices.

For IP5.02.03 Metrics from the 2023 national survey provide a baseline to compare progress in regional and remote CE Innovation in a number of dimensions including:

- Materials of most concern to regional and remote local governments
- Presence or absence of innovative initiatives addressing them
- Progress of initiatives against a 4 phase S-curve analysis
- Types of partnerships and collaboration in initiatives

These will be further augmented by 2025 work to explore case study analysis across regional initiatives in Australia, and this in turn will help inform interpreting the implications of a re-measure of the national survey in 2026.

For **IP5.02.04**

- Integration of Indigenous Knowledge into Sustainability Strategies – Recognition and application of Indigenous cultural and ecological knowledge in circular economy approaches.
- Sustainable Indigenous Business Models – Establishment of long-term, circular economy enterprises owned and operated by Indigenous communities.
- Indigenous Leadership in Waste Management Policy – Active participation of Indigenous leaders in shaping national and regional waste and resource recovery policies.
- Enhanced Economic and Employment Pathways – Early-stage opportunities for Indigenous enterprises to engage in resource recovery, waste repurposing, and sustainable business models.
- Systemic Change in Circular Economy Approaches – Institutional adoption of Indigenous-led sustainability solutions, creating place-based, community-driven circular economy strategies.
- Intergenerational Knowledge Transfer – Sustainable education and leadership programs ensure Indigenous youth continue to play a key role in circular economy practices.
- Economic and Social Empowerment – Strengthened community resilience, assist in job creation, and economic independence through sustainable business and resource management initiatives.

These qualitative outcomes illustrate the project's progression from initial engagement and knowledge-building to long-term economic and environmental sustainability, with Indigenous leadership at the core of waste management and circular economy transformation.

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.

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 breath 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.

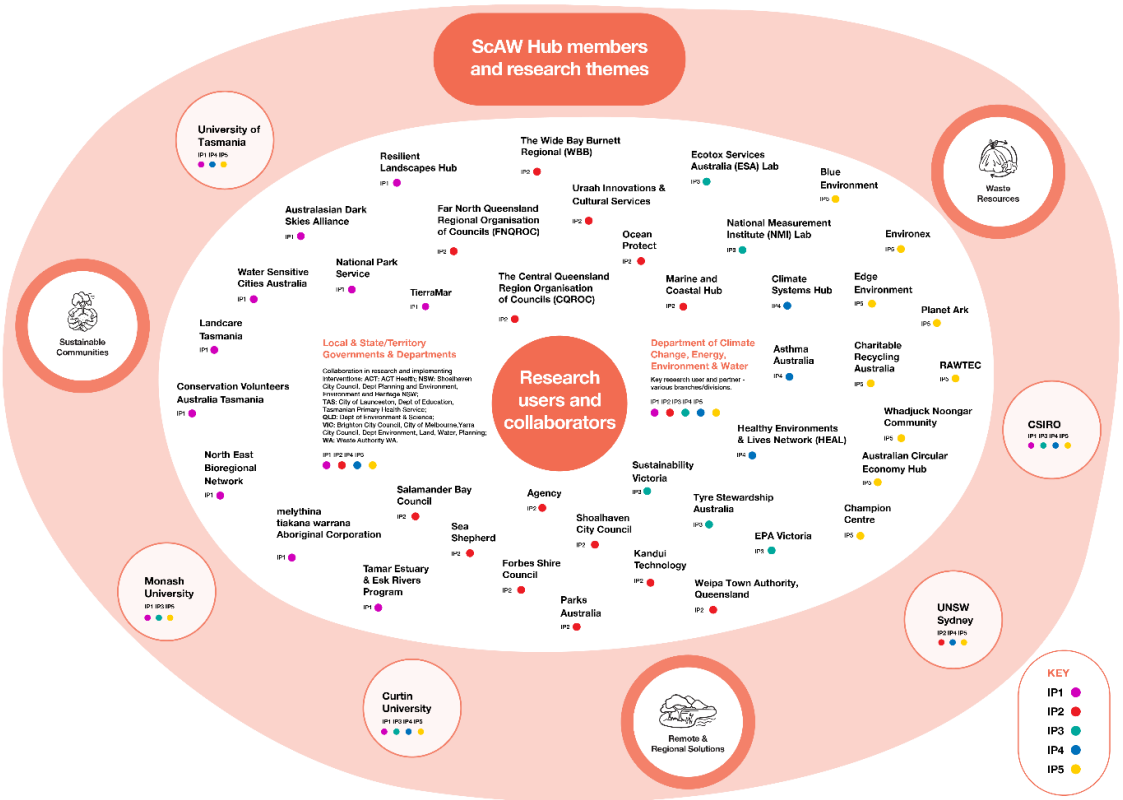

Figure 6: The SCaW Hub Stakeholder Network, which demonstrates the fluid line between hub collaborators and research-users Table 1 summarises cross-hub collaborations occurred for each IP in their respective projects.

Scaw Hub Project Details	Cross Hub Project Details	Cross Hub Linkage Activities
IP1.02.01: Nature connection Project leader: Emily Flies, UTAS	Project: 3.17. Improving environmental outcomes on conserved and managed lands Cross Hub: Resilient Landscapes Project leader: Vanessa Adams	• Stream 1: Not an official cross-Hub stream, though there is and will continue to be collaboration with RL Hub on this stream. • Stream 3: Is an official cross-Hub, Indigenous-led project which will have co-investment of funds across all four Hubs, with a collaborative, cross-Hub codesign process led by our Indigenous partners (MTWAC) with data sharing as appropriate.
	Project: 4.4: An Indigenous-led approach to advance health and wellbeing of Tebrakunna Country, Coastal Plains nation, North-east Tasmania Cross Hub: Marine and Coastal Hub Project leader: Alan Jordan (and Mark Harris, as Indigenous lead at partner organisation, MTWAC)	• Stream 3: Is an official cross-Hub, Indigenous-led project which will have co-investment of funds across all four Hubs, with a collaborative, cross-Hub codesign process led by our Indigenous partners (MTWAC) with data sharing as appropriate.
	Project: 2.5: Regional climate change guidance for local action and proposed project 4.3: Conservation Adapt' - a cross hub biodiversity adaptation knowledge platform Cross Hub: Climate Systems Hub Project leader: Jennifer Styger	• Stream 3: Is an official cross-Hub, Indigenous-led project which will have co-investment of funds across all four Hubs, with a collaborative, cross-Hub codesign process led by our Indigenous partners (MTWAC) with data sharing as appropriate.
	Project: 2.5. Regional climate change guidance for local action Cross Hub: Climate Systems Project leader: Jason Evans	• There will be a co-investment of funds across hubs, a collaborative co-design process, appropriate data sharing and co-production of knowledge products.

Scaw Hub Project Details	Cross Hub Project Details	Cross Hub Linkage Activities
IP2.02.01: Understanding Microplastics Project Leaders: Prof. Veena Sahajwalla, and Anirban Ghose, UNSW	Project: 2.4. Ecological outcomes of wastewater discharges in contrasting receiving environment Cross Hub: Marine and Coastal Meeting and discussions with Hub leader Alan Jordan Project collaborator: Bronwyn Gillanders	• The collaboration between these two projects will provide opportunity to undertake appropriate tests which is already occurring under IP2 to measure the ecotoxicity investigations on the consequence of contaminants in coastal marine ecosystems. • UNSW and Bronwyn Gillander's Lab at university of Adelaide (collaborator of NESP2.4) initiated working on the investigation and examination of the microplastic samples. • A set of microplastic samples which was collected by Gillander's Lab team was sent to UNSW for further analysis. The received microplastic samples were investigated via a range of different technique including FTIR, TGA-GC/MS, and SEM and the report was sent to the University of Adelaide.
IP4.02.02: How will a changing climate and emissions reduction measures impact sources of air pollution and secondary pollutant formation? Project Leader: Kathryn Emmerson, CSIRO	Project: 2.5. Regional climate change guidance for local action Cross Hub: Climate Systems Project leader: Marcus Thatcher; Hamish Ramsey	• Project 2.5 is providing IP4.02.02 with the climate change modelling for 2048 -2052 so that IP4.02.02 can calculate changes in air quality. • These data will come from 4 GCMs under 2 SSPs (8 simulations in total for 5 years each).

Table 1: Cross hub collaborations with linkage activities

The SCaW Hub conducts annual reviews of its key strategies. Strategies are updated by each strategy leader and shared with other strategy leads for comment. All updated strategies are reviewed by the Hub 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. A review of the strategies took place in early 2023 and resulted in very small modifications to the strategies. As a result, all strategies are progressing well, in line with workplans. As the need for cross-hub activities increases the work of strategy leads will expand to work with other hubs to create cross-hub products.

Knowledge brokering

Knowledge brokering is a pivotal function within the Hub, guided by the Knowledge Brokering Strategy to ensure that research projects are co-designed in accordance with Department guidelines. This ensures that the needs of research-users are met and that knowledge products are delivered in usable and accessible formats, thereby generating research impact and communicating the program-level impact of the Hub.

The Hub's lead Knowledge Broker (KB) orchestrates knowledge brokering activities and functions across the Hub, in partnership with the Department, all Hub partners, Indigenous facilitators, and other NESP hubs, in alignment with the Hub's KB strategy.

Key progress against this strategy in 2024 has included:

- **Creating Impact**: Utilising a Monitoring & Evaluation Framework developed by the Department to measure the impact of Hub outputs.

- **Research Project Co-Design**: Facilitating co-design workshops, connecting SCaW Hub researchers with research-users within the Department and external partners, and ensuring that research-user priorities are addressed in Hub research plans.

- **Knowledge Product Development:** Supporting Impact Priorities (IPs) in developing knowledge products through regular meetings, engaging the Department to ensure research findings are fit for purpose and ready for adoption. These meetings also help understand KB priorities and create robust impacts from research outputs, aligning individual projects with the Hub's broader vision.

- **Cross-Hub Collaboration:** Regular communication with KBs in other hubs to align research, elevate impact, and share experiences and learnings.

- **Stakeholder Engagement:** Conducting sessions with stakeholders within and outside the Department to facilitate the translation of knowledge for different groups.

- **Internal Collaboration:** Supporting other strategic leadership areas, such as Indigenous Partnerships and Data Wrangling, to enhance communication of their research and engagement with research participants, research-users, and the broader public.

Through these efforts, the KB team works closely with all researchers to create reports and knowledge products that are useful for various stakeholders, enabling the transformation of knowledge and outcomes generated as part of our Hub.

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 NESP.

The Hub's Communication and Media Manager has worked closely with the Hub 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 includes regular and targeted engagement with researchers and collaborating with the other strategy leads. This also includes monthly meetings with the NESP hubs Communications Practice Group, which discusses and shares communications matters relating to all four 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 2024 key activities included:

Branding / templates / materials to support IP areas	• New product website landing page template created and disseminated to project teams to complete for recent outputs to improve engagement and accessibility, in line with Hub staff and stakeholder feedback ○ Project in place to create retroactive landing pages for past outputs. • Worked with Hub graphic designer to assign specific colour codes and icons to each IP, for consistency across branding, as seen in the updated Hub Overview 2024 (published early last year)

Website	• General website maintenance and operation
	• Published all new research reports and annual reports
	• Published relevant IP-related sections of research reports for each IP
	• After the home page, the top three visited web pages of 2024 were:
	  1. Impact Priority 2 - Plastic and waste materials
	  2. Impact Priority 1 - Sustainable people-environment interactions
	  3. Research webpage
	• Top referrers to the website are:
	  1. DCCEEW website
	  2. Typed/Bookmarked
	  3. Tyre Stewardship Australia website
	  4. Organic search
	  5. LinkedIn
	• Top 5 countries of visitors:
	  1. Australia
	  2. United States
	  3. Germany
	  4. Poland
	  5. India
	• Published updates to operational changes (e.g. personnel changes)
	• Extensive publication of news and event posts

	• Added 'year published' to all output buttons on website to improve product clarity as well as version labels where needed. • Divided outputs into projects on IP webpages to improve accessibility. • Began capturing needs and feedback from internal and external Hub staff to inform the 2025 website update project.
News	• Wrote and published 20 news items on website.
Events	• Community events: The Hub leader and IP leads have spoken at more than a dozen community-based events in 2024, promoting the Hub and its work. • Industry events: The Hub leader has spoken at another dozen industry-specific events, building awareness of and collaboration opportunities for the Hub at an industry level. • Hub events: The Hub communications function delivered the communications support for the NESP conference in April.
Media	• Media exposure: Various media mentions from Hub staff

Videos	• Two new videos published in 2024
	  ○ Key Thinkers Forum on Air Quality, Asthma & Indigenous Health Recap
	  ○ The Hub is supporting the development of a circular economy | Sustainable Communities and Waste Hub

Social media handles (LinkedIn, Bluesky and X)	• Wrote and published posts for all website news and event stories, including linking to SCaW Hub site posts and other relevant curated content (such as reposting relevant DEECCW posts)
	• Resharing past products and outputs on social media to continue to drive engagement.
	• Significant LinkedIn engagement:
	  ○ Posts: 69
	  ○ Impressions: 15,486
	  ○ Followers: 1,742 (+180)
	• Creation of Blue Sky account to complement X (Twitter) posting in Dec.

Newsletters	• Quarterly internal newsletter updates from KB team. • SCaW provided regular NESP news newsletter content for the Department. • Began MailChimp email list sign up option on website to capture emails.
Knowledge product support and management of approval process with NESP	• Working with IP leaders to identify their project's key messages that need to be communicated to different stakeholders. • Working with other hubs to create joint communication pieces as part of cross-hub products about complimenting research topics.
Internal communications	• Began quarterly whole-of-hub communications meetings to create a platform for collaboration as well as to co-develop cross-project and whole-of-hub messaging, outputs and impact. • Review and proofread a variety of Hub communication products to ensure they are in line with the style guide, have correct messaging and are engaging and accessible.

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 leadership team and reviewed with minor administrative updates made in November 2022. The Hub has continued to deliver key activities against the Indigenous Partnerships Strategy in 2024 including:

Right to Indigenous cultural and intellectual property: Several more Hub members have attended True Tracks Training to better understand Indigenous cultural and intellectual property. These training sessions have been shared between the Marine and Coastal Hub and the Resilient Landscapes Hub for a more cost effective and time efficient arrangement.

Co-created research: Cultural capabilities have increased, and the Hub in some areas is seeing more engagement with Indigenous populations.

Indigenous partnership approach: The three-category approach was revised and has been implemented for the hub. The Senior Indigenous Facilitator has worked together with the Indigenous Knowledge Brokers and other Hub Facilitators as part of the Indigenous Facilitation Network to fine tune the content as well as communicate the changes outwardly. Additionally, the Senior Indigenous Facilitator made content contributions to the revised three category approach, she recommended the flow chart to quickly determine which category is relevant for a project. Further, she was involved in the consultation around best approaches for training delivery of the revised approach. Training sessions were available to all hub members throughout 2024 to learn more about the changes to the three category approach should they wish to attend.

Facilitation and governance: The Hub remains actively engaged in the Indigenous Facilitation Network (IFN) through the Senior Indigenous Facilitator. Other key activities undertaken by the Senior Indigenous Facilitator included:

- Delivering a presentation for the DCCEEW showcase in May 2023.
- Participation in a workshop with the IFN which included her arranging a visit for the Facilitators and Indigenous Knowledge Brokers to the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS). The visit provided access to attendees to the collections within the Stanner Room and an opportunity to engage with collections management staff regarding appropriate protections and storage of Indigenous knowledge and artefacts.
- Active involvement in providing input into the revised version of the three-category approach. The input has included contributions to the design, the roll out and training in its application.
- Contributed as part of two panels for the 2024 National Environmental Science Program Conference Partnerships Science Impact. The panels were titled “Indigenous Facilitation Network Panel Discussion” and “Australia in 2050”.
- Ongoing work with the Indigenous Facilitation Network for the revised three category approach roll out and developing a Cultural Security Framework for NESP.
- Worked closely with research leads of impact priority 4 and the Hub communications manager to develop a short video to outwardly communicate the research impact of the Key Thinkers Forum on Air Quality, Asthma & Indigenous Health. This can be accessed here: https://www.nespsustainable.edu.au/key-thinkers-forum-air-quality-asthma-indigenous-health-recap

- Assisted with the recruitment of an Indigenous research assistant to join IP5.02.04 and provided cultural guidance and edits to outward facing communications regarding the research impact of this project.

Key projects that exemplify our commitment to Indigenous leadership, knowledge systems, and governance:

IP1.02.02 Water Sensitive and Liveable Communities

The core aim is to improve water sustainability and liveability outcomes for First Nations peoples across Australia by embedding Indigenous knowledge, leadership, and governance into water research and policy frameworks.

(Please refer to page 15 for more details)

IP4.02.01: Let's yarn about smoke

Building on the relationships that were made resulting from the Key Thinker's Forum the SCaW Hub is supporting a CSIRO-funded smoke messaging research project in collaboration with partners in New South Wales, the Northern Territory, and Western Australia

(Please refer to page 18 for more details)

IP5.02.04: Identifying opportunities from waste management and resource recovery and the circular economy for Indigenous communities and businesses

This ongoing work reinforces the project's commitment to Indigenous engagement, leadership, and sustainable waste management solutions while fostering economic opportunities within Indigenous communities

(Please refer to page 23 for more details)

Data management

The Data Wrangler has maintained active communication and collaboration with each Impact Priority to support awareness and utilisation of data generated within the Hub in 2024. Through ongoing engagement, researchers have articulated data challenges and requirements, facilitating a deeper understanding of research-user needs across government, industry, and communities. These interactions have also reinforced the application of FAIR and CARE data principles, ensuring that high-quality data products contribute to broader impact beyond NESP.

A key partnership in 2024 has been the collaboration with the Australian Research Data Commons (ARDC), Australia's leading research data infrastructure facility. ARDC supports researchers and their organisations in developing digital research services and data solutions that maximise societal impact. As part of its Domain Data Portals (DDP) program, ARDC aims to improve access to Findable, Accessible, Interoperable, and Reusable (FAIR) data. This project commenced on 30 May 2024 and will continue for the duration of NESP.

The SCaW Hub's partnership with ARDC is focused on establishing a data management framework that enhances the findability and interoperability of environmental data. Addressing the challenge of fragmented data across institutional repositories, the project will implement standardised metadata protocols and uniform persistent identifiers (PIDs) to streamline the management and sharing of the

Hub's research outputs. By providing a framework for storing research outputs in national information repositories, the initiative will ensure that Hub-generated data is accessible and actionable for government and stakeholders. This work will support evidence-based decision-making and broader engagement with stakeholders while strengthening the long-term impact of the Hub's research.

The Data Wrangler has engaged with key institutional repositories, including UNSWorks, to assess their capabilities in storing SCaW Hub data, their metadata requirements, and their capacity to support persistent identifiers (PIDs), such as the forthcoming Research Activity Identifier (RAiD), beyond the Hub's duration. Understanding these repository requirements is essential to ensuring the findability and interoperability of high-quality research outputs, maximising their long-term accessibility and impact.

Hub-level risk management

All risks identified in the Hub's risk management plan are being actively managed.

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 RP 2021, RP2022, RP2023 and RP2024 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 leads 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 RP2024.