Scaling up

the Western Australian Restoration Economy

Research priorities for guiding investment and effort towards a nature positive future

The Western Australian Biodiversity Science Institute

Acknowledgements

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Acknowledgement of Country

We acknowledge the traditional custodians throughout Western Australia and their continuing connection to, and deep knowledge of, the land and waters. We pay our respects to Elders both past and present.

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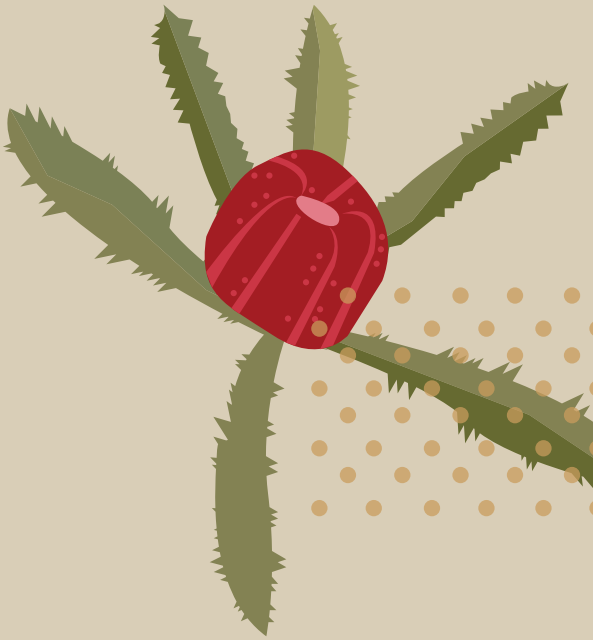

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Restoration Economy

Research priorities for guiding investment and effort towards a nature positive future

August 2025

Prepared by

The Western Australian Biodiversity Science Institute (WABSI)

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Contents

Executive Summary

Background

Ecological restoration is essential to addressing the climate and biodiversity crises. Achieving global nature positive goals—halting and reversing impacts on species and ecosystems—is critical for sustaining economies, livelihoods, and collective wellbeing.

The urgency for large-scale, high-quality restoration has never been greater. Meeting this challenge requires a rapid expansion in the capacity and capability of the restoration economy.

In Western Australia, this economy is growing and demand for restoration is expected to continue to increase in both scale and complexity. However, building a robust industry will require a coordinated, cross-sector strategy involving government, NGOs, business, philanthropy, education, practitioners, and landowners.

There is a need to deepen our understanding of how ecosystems recover and the conditions that enable successful restoration outcomes, both directly, and, in the broader enabling environment.

To guide this transition to a nature positive future, a **Western Australian restoration economy research prioritisation** was initiated to identify critical knowledge gaps and inform project development that can be targeted for investment.

Credit: Threshold Environmental

Approach

A process to scope, define and prioritise research needs was undertaken in alignment with the WABSI program development pathway. This approach follows an iterative process engaging both end users and researchers. Stakeholders help scope, define and set research priorities. In this program we engaged through various platforms and strategies including online surveys, one on one consultations, and workshops to define and refine the program scope and priorities.

Framework for the Western Australian restoration economy research prioritisation

Stakeholder engagement during program development helped to inform a framework for research priorities. Key questions emerged that informed the architecture for this framework. These included:

- Why are we undertaking restoration?
- How do we generate greatest value?
- Where should we be doing restoration?
- What kind of restorative activity are we doing/should we be doing?
- How do we strengthen capacity and capability for on ground action?
- How do we maximise biodiversity outcomes?
- How do we track progress?
- How should we communicate results and contribute to wider learning?

Priority areas explored in the survey and consultations were aligned with key questions to develop a framework for the research prioritisation. Given the complexity and scale of the Western Australian restoration economy the prioritisation is presented in two parts.

Part A outlines the strategic issues affecting the development and operation of a restoration economy across the state. The research priorities are organised under four key themes: purpose, plan, deliver and knowledge. Common to each theme is the priority to support Indigenous Australians in the restoration economy to help heal Country. Within each theme a number of research focus areas, outcomes and objectives are identified to address critical knowledge gaps.

In addition to the overarching research prioritisation presented in Part A, stakeholders from individual industries including carbon, Natural Resource Management, mining, forestry, infrastructure, pastoral Rangelands, and broadacre agriculture and livestock articulated key challenges that were largely common across actors within their respective groups. Thus, **Part B** provides insight into these specific challenges. These knowledge gaps are no less important to address but have a more specific focus than those presented in Part A.

PART A: Overarching statewide research prioritisation for the restoration economy

	Focus Area	Outcome	Objectives
Purpose	**Benefits**	• Benefits of restoration are understood and valued. They can be weighted and considered in restoration planning to maximise impact.	• Understand approaches for maximising and valuing benefits. • Demonstrate projects that are maximising benefits.
	Markets and compliance	• Active contribution to environmental markets with projects that are robust and reporting with confidence throughout the State. • Restoration projects are effectively offsetting impacts of habitat loss from approved development activities.	• Develop business cases for engaging and investing in nature. • Indigenous-led and co-designed restoration project models that can be valued appropriately in environmental markets.
Plan	**Prioritisation**	• Institutional coordination and alignment on a restoration strategy for the state which supports the strengthening of cultural and environmental repair.	• Undertake landscape scale regional planning that identifies priority areas for restoration efforts. • Develop strategies for overcoming land access and tenure constraints. • Land availability and supply analysis that incorporates mapping, modelling and viability assessment.
	Climate resilience	• Restoration is employed to mitigate the adverse impacts of climate change and biodiversity loss in Western Australia. Ecological restoration plantings are resilient to an altered landscape and climate.	• Model how ecological restoration can be used to mitigate climate change impacts. • Understand how ecosystems will shift with a changing climate and provide data to inform what to plant for resilient systems. • Revise and refine modelling of carbon sequestration potential in restorative projects.

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Credit: Megan Hele (middle)

PART A: Overarching statewide research prioritisation for the restoration economy (continued)

	Focus Area	Outcome	Objectives
Deliver	**Workforce and enterprises** 	• A restoration economy workforce that is appropriately trained and has capacity to respond to scaling restoration efforts.	• Understand and plan for a workforce capacity and expertise needed for a robust restoration economy as it matures.
	Restoration practice 	• Restoration practitioners able to deliver restoration at scale and achieve the desired level of recovery.	• Understand the supply chain requirements for a robust restoration economy as it matures. • Adopt a policy of future practice to continually address knowledge gaps and improve on restorative outcomes.
Knowledge	**Monitoring and audit** 	• Restoration projects are regularly monitored utilising a consistent approach and outcomes shared for collective learning. Data is used to support Western Australian State of the Environment reporting and public baselines.	• Develop an effective and efficient monitoring framework that supports restoration projects with different drivers and end land-uses. • Build a repository for sharing restoration projects, approaches, monitoring outcomes, and level of recovery achieved. • Build a state-wide set of maps that can act as/provide baseline information.
	Extension 	• An engaged cross-sector restoration industry that shares data and information from restoration projects to collectively contribute towards environmental repair and species conservation.	• Reinvigorate the extensive on-ground regional network of Landcare and NRMs to strengthen the knowledge translation and community enthusiasm for restoration. • Science communication is embedded in restoration projects.

PART B: Industry focussed research priorities for the restoration economy

Industry	Outcome	Objectives
Carbon	• Carbon projects are well suited to their locations and maximise biodiversity on site.	• Projects are weighted and balance the benefits of carbon and biodiversity to obtain greatest impact for the site/region/state.
Natural Resource Management	• NRMs are directing restorative actions in their catchments in collaboration with government and industry. • For-purpose organisations, community and people are valued in their role to deliver restoration and collaborate for landscape scale initiatives.	• Increased opportunities and revenue for NRM regions to have resources for management of local issues and support priority environments. • Empower and support for-purpose organisations and communities to actively participate in and lead restoration efforts, fostering collaboration and partnerships that enable inclusive, landscape-scale environmental outcomes.
Mining	• A sustainable mining industry that understands its impacts on nature and is committed to working towards nature positive.	• Understand how to integrate nature impacts and restoration into life of mine planning with business cases to support investment into the resourcing needs (e.g. seed, personnel) to undertake restoration at scale.
Forestry	• A clearly articulated role for forestry within the restoration economy.	• Build understanding of the risks/benefits of employing ecological thinning as a restorative management tool. • Demonstrate how biodiversity can be considered in private plantations and contribute to nature positive outcomes.
Infrastructure and development	• Western Australia's infrastructure networks are valued for their connectivity and provide critical habitat and ecosystem exchanges.	• Understand the role of restoration within development and infrastructure corridors and how to improve condition to support landscape connectivity.
Pastoral Rangelands	• Pastoral Rangelands are managed sustainably, and stations have the opportunity to engage in environmental markets to diversify income, resulting in increased environmental condition.	• Develop a suite of economically feasible approaches that can be implemented in the Rangelands to improve environmental condition.
Broadacre agriculture and livestock	• Restoration is an integral part of farming systems that enhances productivity and supports access to premium markets. Actions support biodiversity and broader environmental condition.	• Guidance on how best to integrate restoration into farming practices to optimise benefits and return on investment.

Key priorities summary

Consultation with stakeholders and end users identified the following focus areas as having the greatest need for targeted research to support the Western Australian restoration economy.

1. **Benefits** — Benefits of restoration are understood and valued. They can be weighted and considered in restoration planning to maximise impact.
2. **Prioritisation** — Institutional coordination and alignment on a restoration strategy for Western Australia which supports the strengthening of cultural and environmental repair.
3. **Monitoring and audit** — Restoration projects are regularly monitored utilising a consistent approach and outcomes shared for collective learning. Data can be used to support Western Australian State of the Environment reporting and public baselines.

Next steps

The implementation of this research program will require an effective governance structure and significant resources. A dedicated steering committee would provide the required oversight to facilitate the delivery of this program, a model that works successfully with WABSI research programs.

Strong alignment with research initiatives underway locally, nationally and in other states, and with relevant regulatory and policy bodies will enhance outcomes and reduce the risk of overlapping effort.

Multiple sources of funding, including Commonwealth and State Government funding schemes, impact investments, and philanthropic sources, are all realistic options that support end user driven research.

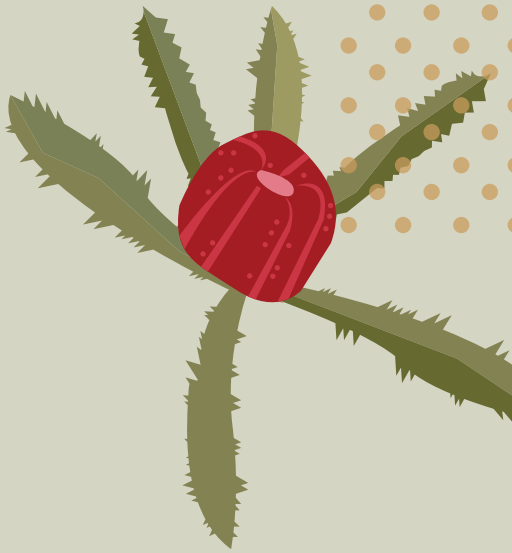
We encourage land managers and the research community working in the restoration economy in Western Australia to share and discuss their interests, management challenges and opportunities with us and engage with the delivery of this program as we seek to transform this collaborative work into tangible on-ground impact.

Credit: Preeti Castle (middle) and Lochman Transparencies (right)

Acronyms

CER	Clean Energy Regulator
CER ACCU	Clean Energy Regulator Australian Carbon Credit Units
CIA	Cumulative Impact Assessment
CISS	Centre for Invasive Species Solutions
CMI	Carbon Market Institute
CRC	Cooperative Research Centre
CRC TiME	The Cooperative Research Centre Transformations in Mining Economies
CRC-P	Cooperative Research Centres Projects
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Department of Agriculture, Fisheries and Forestry
DAFWA	Department of Agriculture and Food, Western Australia
DBCA	Department of Biodiversity and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DWER	Department of Water and Environmental Regulation
ECU	Edith Cowen University
eDNA	Environmental DNA
EMSA	Ecological Monitoring System Australia
EOI	Expression of Interest
EPA	Environmental Protection Authority
EPBC	Environment Protection and Biodiversity Conservation
ESD	Ecological Sustainable Development
ESG	Environmental, Social and Governance
EU	Europe
FMP	Forest Management Plan
FullCAM	Full Carbon Accounting Model
GBF	Global Biodiversity Framework
GDP	Gross Domestic Product
GIS	Geographic Information System
HBI	The Harry Butler Institute
IBSA	Index of Biodiversity Surveys for Assessments
ICMM	The International Council for Mining and Metals
IFLM	Integrated Farm and Land Management

NCA	Natural Capital Accounting
NESP	National Environmental Science Program
NESP2	National Environmental Science Program Phase 2
NGO	Non-Governmental Organisation
NRM	Natural Resource Management
OAG	Office of The Auditor General
OH&S	Occupational Health and Safety
PEOF	The Pilbara Environmental Offsets Fund
RIAWA	Revegetation Industry Association of Western Australia
ROI	Return on Investment
SAFE	Shared Analytic Framework for the Environment
SER	Society for Ecological Restoration
SERA	Society for Ecological Restoration Australasia
SME	Small to Medium Enterprise
SPA	Seed Production Area
TAFE	Technical and Future Education
TEK	Traditional Ecological Knowledge
TNFD	Taskforce on Nature-related Financial Disclosures
UCL	Unallocated Crown Land
UK	The United Kingdom
US	The United States of America
UWA	The University of Western Australia
UWA NESP	The University of Western Australia National Environmental Science Program
WA	Western Australia
WABSI	The Western Australia Biodiversity Science Institute
WARE	Western Australia restoration economy
WAVE	Western Australian Vegetation Extent
ZNE-Ag CRC	Zero Net Emissions Agricultural Cooperative Research Centre



1. Introduction

Ecological restoration is a fundamental part of the solution to tackling the climate and biodiversity crises. Global nature positive goals, whereby impacts to species and ecosystems are halted and reversed, are critical to support our economies, livelihoods, communities and collective wellbeing.

The urgency for quality restoration at scale has never been greater, but this requires a rapid increase in capacity and capability of the industry through the restoration economy.

In Western Australia, the restoration economy is growing with restorative-based projects becoming increasingly common. The demand, scale and quality of such projects is expected to increase, but a robust industry will require a multi-faceted strategy that spans government, non-government organisations, business, philanthropy, education, practitioners and landowners (Young et al. 2023).

We define the restoration economy as:

> ***"The market of businesses, investors, consumers, community, and government initiatives engaging in or driving the economic activity related to ecological restoration"*** (modified from Young et al., 2023).

Western Australia is responding to the needs of the restoration economy, but while building and implementing policy to support the industry, there is also a requirement to advance our learning and understanding of the ecological recovery of the systems and the enabling environment that supports it.

As such, it was recognised that a Western Australian restoration economy research prioritisation was needed to identify knowledge gaps to target for potential investment opportunities and support the shift to nature positive.

Definitions and included activities

We adopt the Society for Ecological Restoration's (SER) definition for ecological restoration as:

> ***"Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed"*** (Gann et al., 2019).

The restoration economy captures all activities involving human capital associated with the delivery of ecological restoration including direct (e.g., seeding/planting, land forming, weed management, monitoring) and indirect (e.g., administration, regulation) actions.

It includes ecological restoration of all kinds of ecosystems (e.g., forests, wetlands, grasslands, marine), following all kinds of disturbance (e.g., urban development, agricultural expansion, pastoral activities, mining).

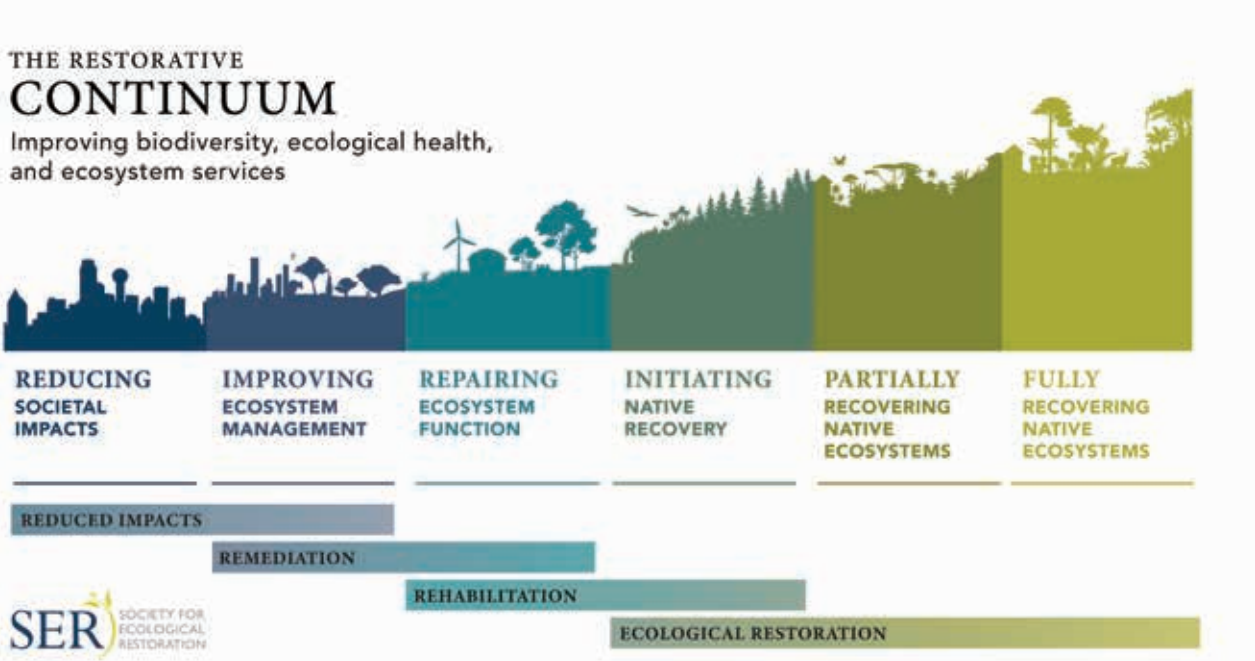


FIGURE 1: The restoration continuum (Gann et al. 2019)

In alignment with the Global Biodiversity Standard (Bartholomew and Mosyaftiani et al. 2024), the restoration economy aims to improve biodiversity outcomes through the full range of the restoration continuum (Figure 1) including restorative agricultural practices and tree planting, rehabilitation, and restoration. This can occur in completely degraded sites or in remnant vegetation (formally protected or unprotected) where there is the opportunity to improve condition (Figure 2).

FIGURE 2: Tree planting, rehabilitation and ecological restoration, agriculture initiatives and protected areas are all captured within the restoration economy and are activities consistent with the Global Biodiversity Standard certification (Adapted from Bartholomew and Mosyaftiani et al. 2024)

Credit: Tranen Revegetation Systems

2. Research program objective

A step change in the quantity and duration of funding and resourcing to undertake research to develop the Western Australian restoration economy is crucial to address knowledge gaps and deploy new knowledge generated.

To address these needs, WABSI has acted on end user led momentum to initiate the development of a prioritised research program for the restoration economy in Western Australia. WABSI research programs bring together a diversity of stakeholders to achieve consensus on the most important factors limiting progress against challenges of great importance for biodiversity conservation.

This publication has been prepared for a broad audience of stakeholders, including research providers, funding bodies, regulatory authorities, practitioners, industry, utilities, the full range of land managers in the state, as well as members of the general public with an interest in biodiversity conservation and restoration. As such, the program needs to cover the interests of a very diverse stakeholder group, despite being end user led. This research program provides a framework for identifying and implementing the highest priority research for an impactful restoration economy, and a pathway to maximise the adoption of that research to improve on-ground outcomes.

In developing this program on the restoration economy, it is clear that:

- Western Australia needs to capitalise on opportunities being presented through evolving environmental markets but also recognise that the reasons for undertaking restoration are much more than economics, with significant social, cultural and environmental benefits able to be considered essential.
- There is a need to understand how best to integrate the restoration economy with other industries so they can operate in a complementary manner in perpetuity.
- It will require support to cultivate the capability and capacity to deliver restoration at scale through commercial enterprises and ensure that this delivery is achieving best practice.
- Knowledge sharing and translation is critical to rapidly upscale the restoration economy by ensuring that scientific research, Indigenous knowledge, and on-ground experience are accessible, integrated, and applied in practical, scalable ways across sectors and landscapes.

It is recognised that the restoration economy research prioritisation needs to capture projects of all scales, ranging from single sites, to regions, to state-based challenges. It also needs to support activities that deliver a range of outcomes along the restorative continuum, and that impact will be maximised when a variety of activities can interconnect and be complementary.

Vision

An integrated, resilient, purpose-oriented restoration economy delivering nature positive environmental change, supported by coordinated research.

Objective

To provide prioritised and clearly articulated research themes, focus areas and actions aimed at enabling the Western Australian restoration economy and increasing restoration scale, quality and effectiveness.

By articulating a clear pathway from knowledge generation to on-ground uptake, this program will encourage complementarity and collaboration and will provide clarity on how best to assist in translating research findings into improved outcomes for end users.

Outcomes

Priority knowledge gaps of the Western Australian restoration economy are addressed with new research.

Research outcomes are relevant, timely and accessible, effectively enabling end users to scale and improve on-ground outcomes.

3. Research program development

A process to scope, define and prioritise research needs was undertaken broadly following the WABSI program development pathway (Figure 3). This approach follows an iterative process engaging both end users and researchers. Stakeholders help scope, define and set research priorities.

In this program we engaged through various platforms and strategies including scoping, online surveys, one on one consultations, and workshops to define and refine the program scope and priorities. A list of stakeholders that contributed to the program is provided in Appendix 1.

In the process of refining feedback after the one-on-one consultations, it was recognised that challenges span five solution components: Research (including social research), funding, communications, policy and management (Figure 4). WABSI's remit in this space relates specifically to the research category, as well as where the other four categories interact or overlap with research to improve outcomes.

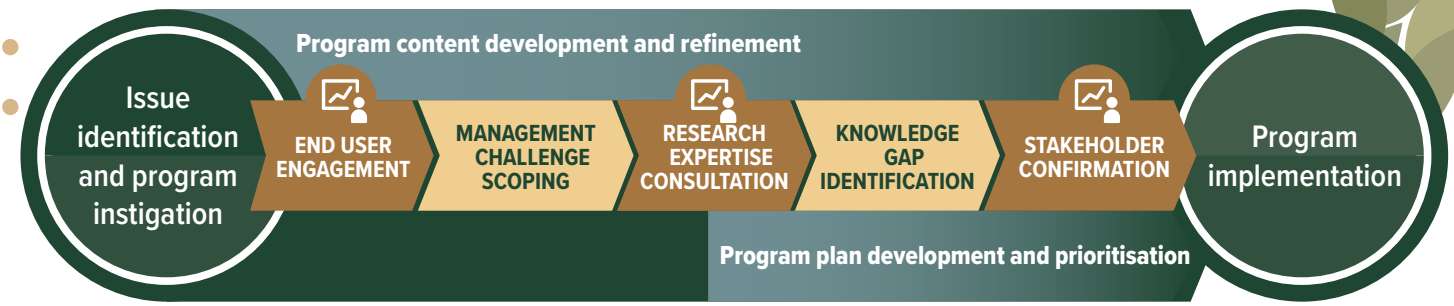


FIGURE 3: The WABSI research program development pathway

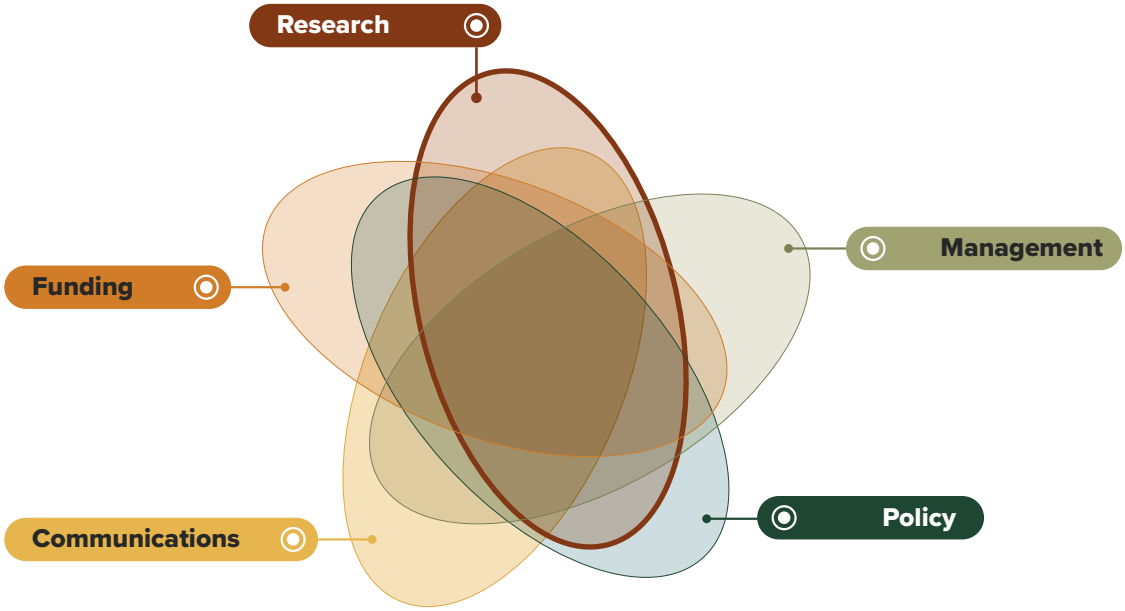


FIGURE 4: Restoration economy challenges are recognised to span five solution components: research, funding, communications, policy and management

2022 Scoping research

The 2022 Western Australian restoration economy (WARE) project aimed to assess the scope and scale of the restoration economy in Western Australia. To this end, WABSI conducted a market-based assessment and gap analysis, resulting in a draft roadmap designed to enhance the state's capacity to deliver effective, large-scale ecological restoration, both individually and collectively. Appendix 2 provides a summary of the key findings from the Young et al. 2023 Western Australian restoration economy report. The full results and report are available for download on the WABSI website[1].

[1] Western Australian restoration economy report https://wabsi.org.au/wp-content/uploads/2023/11/WA-Restoration-Economy-Report-2-2.pdf

2024 Restoration economy research prioritisation

Program survey

A preliminary scoping survey was open to government, research, industry and the community (Figure 5) and undertaken to inform the restoration economy research prioritisation. This provided an opportunity for stakeholders to identify key topics/questions that need addressing in the State to improve on-ground restoration outcomes and broader environmental benefit.

The aim of the survey was to gain a preliminary insight into categories that may emerge as requiring a higher prioritisation. The survey was open from October-December 2023.

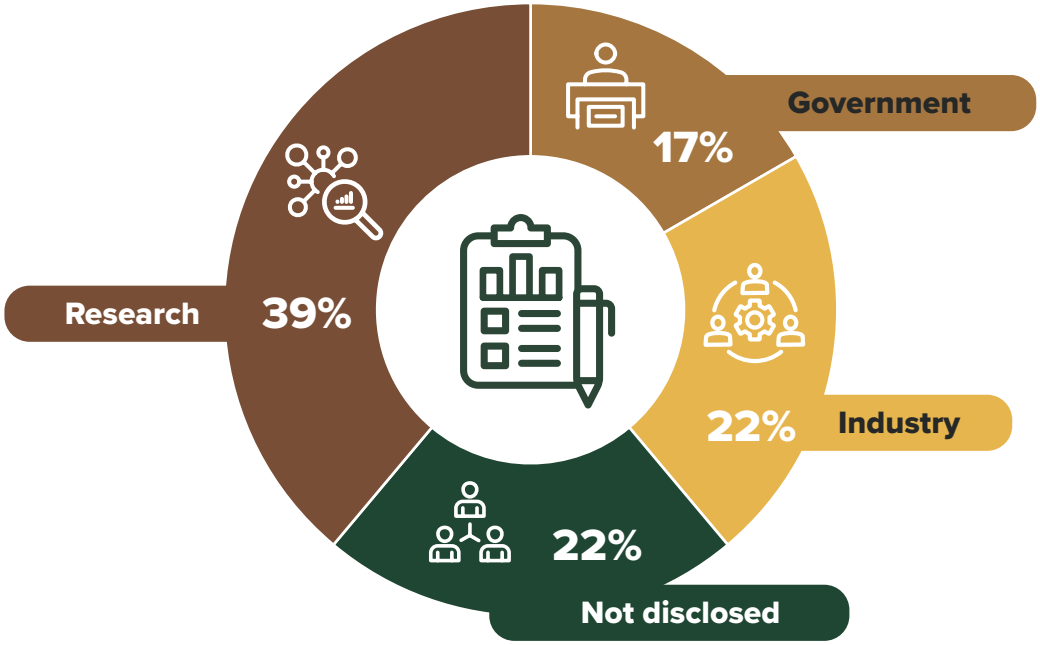


FIGURE 5: Participants of the restoration economy Program Survey

Credit: Megan Hele (right)

Recognising that the restoration economy is a mosaic of interconnected activities, 14 key areas were identified/confirmed that relate to challenges in scaling the Western Australian restoration economy. These included:

1. Overcoming establishment barriers
2. Scaling up technologies
3. Restoration in a changing climate
4. Above and below ground carbon sequestration capacity in restored systems
5. Site prioritisation and landscape planning for restoration
6. Monitoring technologies for ecological restoration
7. Understanding what levels of recovery can currently be achieved
8. Traditional Ecological Knowledge (TEK) and Indigenous land management practice for ecological restoration
9. State-based/ regional restoration guidelines
10. National and International governance structures that support a restoration economy
11. Natural Capital Accounting (NCA) and valuing nature
12. Cultural, social, and economic benefits from ecological restoration
13. Workforce capacity assessment in WA
14. Restoration for advanced offsets

These 14 areas were taken forward into program consultations to explore challenges in greater detail.

Credit: Preeti Castle

Program consultations

The restoration economy has a large group of relevant stakeholders, with emerging issues diverse and varying. While the typical WABSI research program development pathway prioritisations are completed through a workshop format, it was thought that initially it would be more effective to hold one-on-one consultations with organisations to allow for deeper exploration of key issues. Each consultation was approximately one hour with the WABSI Program Director, Conservation and Restoration. Multiple sessions within an organisation occurred when individuals had conflicting schedules or follow-up meetings were required. Consultations were undertaken between February–September 2024.

Program consultation sessions were an effective means to explore challenges experienced by different stakeholders when engaging in the restoration economy at depth. Stakeholders were asked to identify the top five priorities that they feel need addressing for Western Australia to improve and scale restoration efforts, and then these were discussed in detail. Additional issues not captured within the 14 priority areas presented were also noted.

Points were allocated to priority areas identified, and then tallied to provide a preliminary indication of categories of highest priority (Figure 6). Research questions as they emerged within each category were recorded. Priority areas and questions were then consolidated for ranking in the forthcoming program workshop.

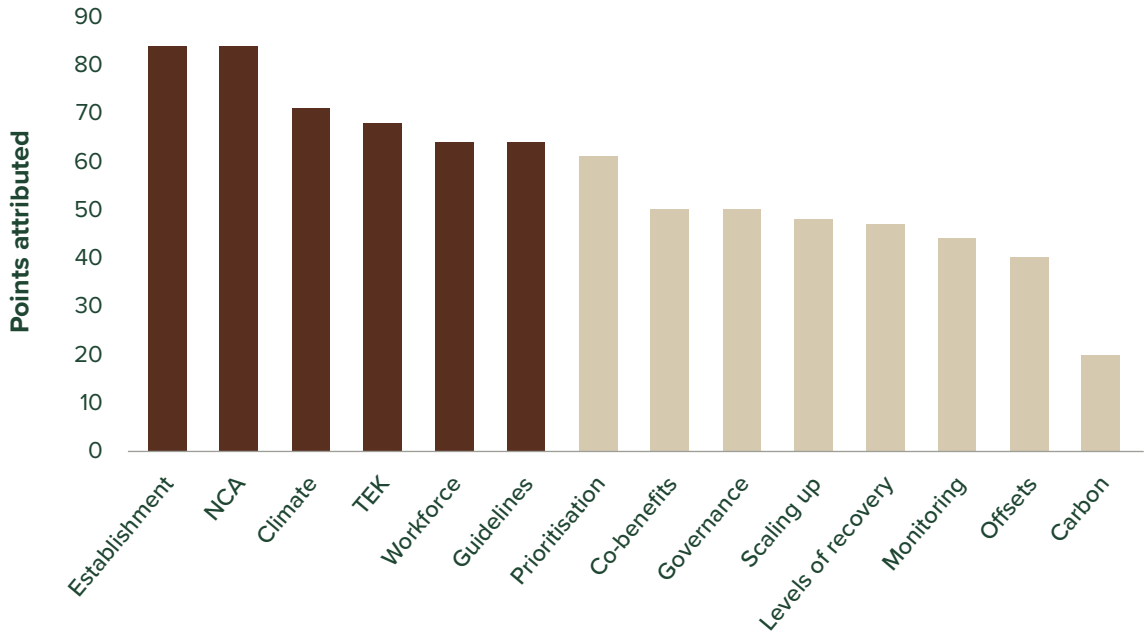


FIGURE 6: Priority areas identified from the program consultations. Red shading indicates top priority areas

Credit: Threshold Environmental

Program workshops

Stakeholders of the Western Australian restoration economy were invited to participate in a research prioritisation workshop either in person (26 March 2025) or online (28 March 2025). Participants worked in groups to rank focus areas of the overarching framework and identified knowledge gaps of each focus area and industry. Opportunity for additional input for any components not assessed was provided out of session in the two weeks that followed the workshop. Outcomes were then synthesised and incorporated into the research framework.

4.

Research program framework

Research program structure

Stakeholder engagement during program development helped to inform a framework for research priorities. Key questions emerged that informed the architecture for the restoration economy research prioritisation framework.

These included:

- Why are we undertaking restoration?
- How do we generate greatest value?
- Where should we be doing restoration?
- What kind of restorative activity are we doing/should we be doing?
- How do we strengthen capacity and capability for on ground action?
- How do we maximise biodiversity outcomes?
- How do we track progress?
- How should we communicate results and contribute to wider learning?

Priority areas explored in the survey and consultations were aligned with key questions and amalgamated to provide a more concise framework for later implementation (Figure 7).

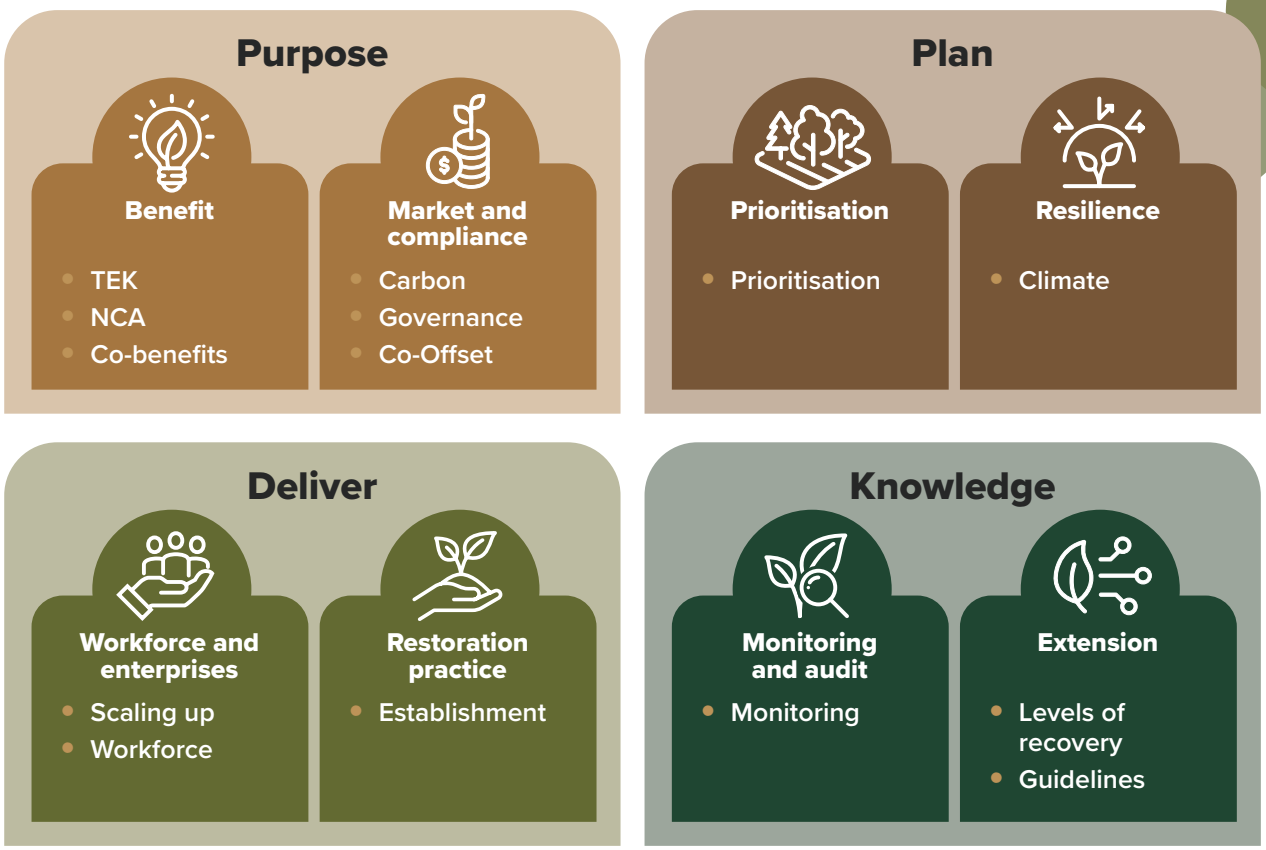


FIGURE 7: Alignment and amalgamation of key areas into the framework

Given the complexity and scale of the Western Australian restoration economy the prioritisation is presented in two parts.

- **Part A** captures strategic issues that impact the functioning of a restoration economy across the State. The overarching framework describes four themes covering the critical gaps in knowledge about the Western Australian restoration economy and key questions that need to be addressed.
- **Part B** provides insight into specific challenges faced within industries and regions. These knowledge gaps are no less important to address, but have a more specific focus than those presented in Part A.

Within each of these themes, end user identified research focus areas and associated knowledge gaps are presented and ranked in order of priority. Example questions as raised by stakeholders in the consultations and workshops are included to inform forthcoming research project development, noting these would be refined with project partners and engaged researchers at a later stage.

While engagement with Traditional Owners was a fundamental part of this process, we acknowledge that the report is shaped by a Western scientific framework. Ranking Indigenous priorities without genuine co-design may be inappropriate and risks misrepresenting or undervaluing culturally significant perspectives. Accordingly, where Indigenous knowledge gaps were raised, they are respectfully marked with a (P) to signal the need for further partnership and dialogue.

Credit: Jesse Collins

Part A:

An overarching research prioritisation for the restoration economy

Key themes and focus areas of the restoration economy research prioritisation are presented across four key themes including purpose, plan, deliver and knowledge. Central to each theme is the priority to support Indigenous Australians in the restoration economy to help heal Country (Figure 8, Table 1). Across themes, it is recognised that the Western Australian restoration economy is a mosaic; a web of interconnected drivers, inputs, activities and outputs and, as such, research topics may not be able to be addressed in isolation. This will require a dynamic approach when delivering the portfolio of research projects.

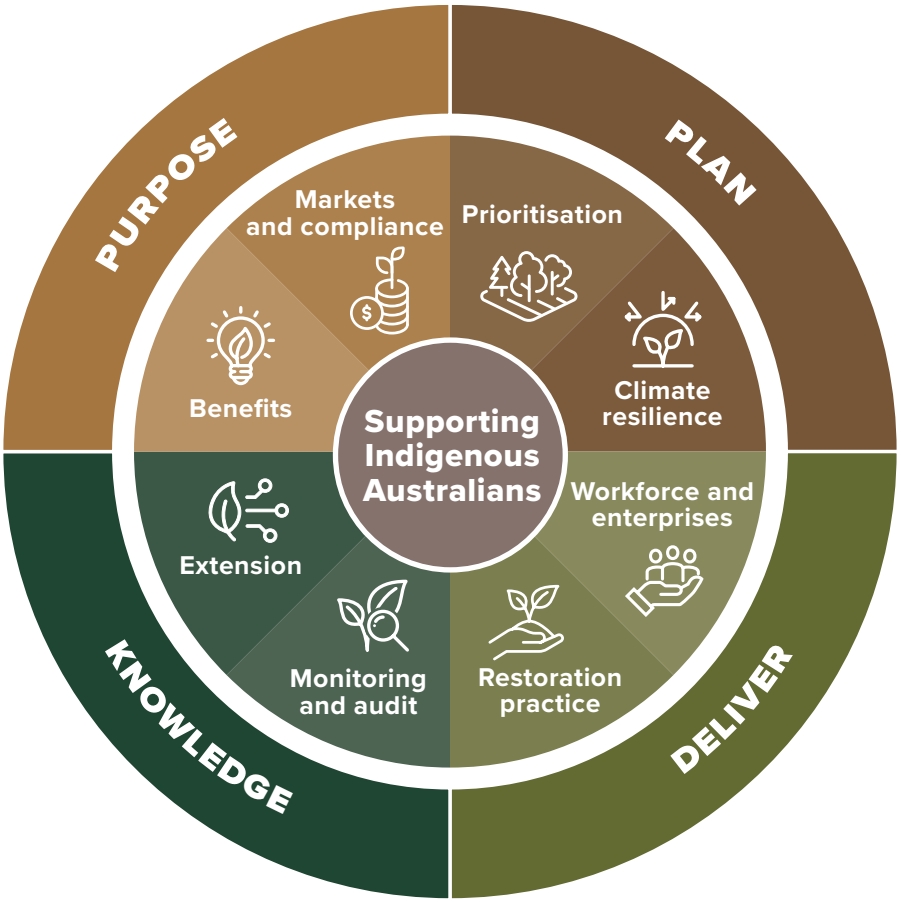


FIGURE 8: A framework for WABSI's research program to address knowledge gaps in the Western Australian restoration economy

TABLE 1: Outcomes, objectives and ranking of the identified focus areas for research within the Western Australian restoration economy

	Focus Area	Outcome	Objectives	Ranking
Purpose	**Benefits** 	• Benefits of restoration are understood and valued. They can be weighted and considered in restoration planning to maximise impact.	• Understand approaches for maximising and valuing benefits. • Demonstrate projects that are maximising benefits.	**1**
	Markets and compliance 	• Active contribution to environmental markets with projects that are robust and reporting with confidence throughout the State.	• Develop business cases for engaging and investing in nature. Highlight the value proposition. • Indigenous-led and co-designed restoration project models that can be valued appropriately in environmental markets.	**4**
Plan	**Prioritisation** 	• Institutional coordination and alignment on a restoration strategy for the State which supports the strengthening of cultural and environmental repair.	• Undertake landscape scale regional planning that identifies priority areas for restoration efforts. • Develop strategies for overcoming land access and tenure constraints. • Land availability and supply analysis that incorporates mapping, modelling and viability assessment.	**2**
	Climate resilience 	• Restoration is employed to mitigate the adverse impacts of climate change and biodiversity loss in Western Australia. Ecological restoration plantings are resilient to an altered landscape and climate.	• Model how ecological restoration can be used to mitigate climate change, biodiversity, land degradation and social effects. • Understand how ecosystems will shift with a changing climate and provide data to inform what to plant for climate-resilient systems. • Revise and refine modelling of carbon sequestration potential in restorative projects.	**5**

(Continued following page)

TABLE 1: Outcomes, objectives and ranking of the identified focus areas for research within the Western Australian restoration economy (continued)

	Focus Area	Outcome	Objectives	Ranking
Deliver	**Workforce and enterprises**	• A restoration economy workforce that is appropriately trained and has capacity to respond to scaling restoration efforts.	• Understand and plan for a workforce capacity and expertise needed for a robust restoration economy as it matures.	**7**
	Restoration practice	• Restoration practitioners able to deliver restoration at scale and achieve the desired level of recovery.	• Understand the supply chain requirements for a robust restoration economy as it matures. • Adopt a policy of future practice to continually address knowledge gaps and improve on restorative outcomes.	**6**
Knowledge	**Monitoring and audit**	• Restoration projects are regularly monitored utilising a consistent approach and outcomes shared for collective learning. Data can be used to support Western Australian State of the Environment reporting and public baselines.	• Develop an effective and efficient monitoring framework that supports restoration projects with different drivers and end land-uses. • Build a repository for sharing restoration projects, approaches, monitoring outcomes, and level of recovery achieved. • Build a state-wide set of maps that can act as/provide baseline information.	**3**
	Extension	• An engaged cross-sector restoration industry that shares data and information from restoration projects to collectively contribute towards environmental repair and species conservation.	• Reinvigorate the extensive on-ground regional network of Landcare and NRMs to strengthen the knowledge translation and community enthusiasm for restoration. • Science communication is embedded in restoration projects.	**8**

Focus areas with highest priority for research

Consultation with stakeholders and end users identified the following focus areas as having the greatest need for targeted research to support the Western Australian restoration economy.

1. **Benefits** — Benefits of restoration are understood and valued. They can be weighted and considered in restoration planning to maximise impact.
2. **Prioritisation** — Institutional coordination and alignment on a restoration strategy for Western Australia which supports the strengthening of cultural and environmental repair
3. **Monitoring & audit** — Restoration projects are regularly monitored utilising a consistent approach and outcomes shared for collective learning. Data can be used to support Western Australian State of the Environment reporting and public baselines.

Credit: Jesse Collins

Theme 1: Purpose

Rationale

The value of nature is receiving increasing attention in recognition that the climate and biodiversity crises are intrinsically linked, with an inability to solve one without also addressing the other. This understanding has led to the development of nature markets, which are increasingly taking shape in Australia. However, the value of nature extends beyond these market-based systems, offering both tangible and intangible benefits to society and the environment.

Focus Area 1: Benefits

Intentionally designed ecological restoration projects can deliver a diversity of benefits with multiple frameworks available to recognise and value these. Benefits include a range of ecosystem services (air and water quality, soil health, temperature regulation), economic revenue, health and wellbeing, social cohesion and cultural and customary connections. Being able to clearly articulate these benefits can support the business case to engage and/or invest.

TABLE 2: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 1 — Benefits

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Benefits of restoration are understood and valued. They can be weighted and considered in restoration planning to optimise impact.	• Understand approaches for optimising and valuing benefits. • Demonstrate projects that are optimising benefits.	• Benefit sharing	• How do we value projects that are Indigenous-led or co-designed and provide fair benefit sharing?	P
		• Benefit categories	• What benefits should we be measuring?	1
		• Assigning value	• How do we assign value (monetary or non-monetary) and report on the benefits and ecosystem services provided by ecological restoration?	2
		• Optimising return on investment (ROI)	• How do we optimise environmental return from social and economic investments? • How do we maximise social return from environmental investment? • Could we develop a model/ tool to understand trade-offs to facilitate decision making (e.g. fire management and benefits for carbon vs biodiversity)?	3

Focus Area 2: Markets and compliance

Climate and nature reporting is one of the key mechanisms to drive Australia to a more sustainable future through the reduction of emissions and impacts on nature. One of the opportunities of market-based systems is access to finance to support on-ground recovery actions. The role of Indigenous people as stewards of Country and the opportunity to strengthen Indigenous-led land management practices within (but not limited to) market-based systems is recognised as a pivotal component of the restoration economy.

TABLE 3: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 2 — Markets and compliance

Outcome	Objectives	Knowledge gap	Example questions	Ranking[2]
• Active contribution to environmental markets with projects that are robust and reporting with confidence throughout the State. • Restoration projects are effectively offsetting impacts of habitat loss from approved development activities.	• Develop business cases for engaging and investing in nature. • Indigenous-led and co-designed restoration project models that can be valued appropriately in environmental markets. • Establish regulatory and monitoring frameworks to ensure restoration projects fulfill offset obligations related to development-driven habitat loss.	**Indigenous-led restoration**		**P**
		• Increasing opportunity for Indigenous people	• What areas of the regulatory framework could be leveraged to increase Indigenous-led and co-designed restoration projects? • Is a biocultural restoration methodology appropriate within environmental markets? • What would a biocultural restoration methodology look like? • How do we build a long-term investment strategy to support an Indigenous restoration economy that can be spiritually orientated and supports the empowerment of its people? • What policy amendments would be required to facilitate Indigenous participation in restoration? • What western science is valuable to support an Indigenous restoration economy?	**Pa**

(Continued following page)

[2] In this Focus Area knowledge gaps are ranked numerically and within each knowledge gap, the sub-categories are ranked with letters

Credit: Megan Hele (middle)

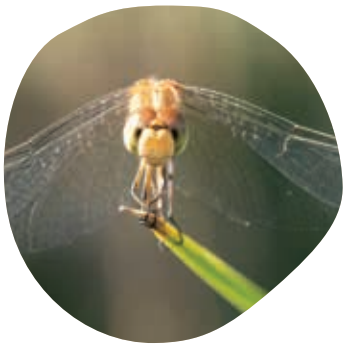
TABLE 3: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 2 — Markets and compliance (continued)

Outcome	Objectives	Knowledge gap	Example questions	Ranking[2]
• Active contribution to environmental markets with projects that are robust and reporting with confidence throughout the State. • Restoration projects are effectively offsetting impacts of habitat loss from approved development activities.	• Develop business cases for engaging and investing in nature. • Indigenous-led and co-designed restoration project models that can be valued appropriately in environmental markets. • Establish regulatory and monitoring frameworks to ensure restoration projects fulfill offset obligations related to development-driven habitat loss.	**Indigenous-led restoration**		**P**
		• Indigenous values	• What does an Indigenous values restoration economy look like, and can it be achieved alongside a market-based system? • What Indigenous values should be included in an environmental market?	**Pb**
		• Indigenous knowledge	• How do we provide the cultural framework that supports Indigenous Australians including ownership of knowledge?	**Pc**
		Nature		**1**
		• Valuing nature	• How do we value nature and biodiversity?	**1a**
		• Alignment with different drivers	• Can we establish a standardised approach for restorative activities that works for different drivers (voluntary, market-based, carbon, compliance/offset)? • What are the opportunities for different restoration activities in Western Australia within environmental markets? • How can we coordinate projects for greater impact?	**1b**
		Economics		**2**
		• Policy	• What policy is currently in place to support environmental markets? and what are the gaps?	**2a**
		• Business case	• What is the business case for investing in restoration? Does this change depending on geography, industry, scale? • What are the incentives/ disincentives for participation in environmental markets? What are the risks? And how can these be managed? • How do we integrate investor goals of reasonable returns on investment (risk and reward) with the biodiversity targets? Can this align with supply with demand?	**2b**

(Continued following page)

TABLE 3: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 2 — Markets and compliance (continued)

Outcome	Objectives	Knowledge gap	Example questions	Ranking[2]
• Active contribution to environmental markets with projects that are robust and reporting with confidence throughout the State. • Restoration projects are effectively offsetting impacts of habitat loss from approved development activities.	• Develop business cases for engaging and investing in nature. • Indigenous-led and co-designed restoration project models that can be valued appropriately in environmental markets. • Establish regulatory and monitoring frameworks to ensure restoration projects fulfill offset obligations related to development-driven habitat loss.	**Compliance**		**3**
		• Minimum requirements	• What levels of recovery are required for relinquishment? • What levels of recovery are required for an offset? • How do you define the recovery gap?	**3a**
		Carbon		**4**
		• Optimising outcomes in Western Australia	• Can carbon and biodiversity 'credits' be stacked without violating additionality? • Can we create social and/or cultural credits? What would they look like? • How can CER ACCU methodologies be improved for Western Australia? What is the effectiveness of FullCAM models? Can these be aligned with current/proposed Nature Repair Market methodologies? • Are there new methodologies or updates to FullCAM methodologies that could create new opportunities?	**4a**



Noongar Elder Eugene Eades
Credit: Threshold Environmental

Theme 2: Plan

Rationale

The demand for restorative activities within Western Australia is growing. The restoration economy will need to be able to effectively integrate with other established industries to successfully contribute to the economy. Land competition is evident, thus there is a need to develop an understanding of how and where we prioritise restoration efforts, and what outcomes we could achieve under different conditions and climates. The restoration economy need not impact or diminish other industries such as agriculture, mining, or construction, but work alongside them, so they are able to continue to operate productively and sustainably.

Focus Area 3: Prioritisation

There is a wealth of expertise and experience in restoration in Western Australia, but also a clear need to understand what is already being done in what locations, and where we should target further time and resources. Some local and regional spatial prioritisations have previously been developed, but Western Australia lacks a common prioritisation that can support collective impact and guide decision making and investment across the range of climates, geographies, end land uses, opportunities and benefits. Both the federal and state governments recognise the role for regional planning in the long-term management of our assets (DCCEEW 2024a, DWER 2022a, 2022b).

Credit: Threshold Environmental

TABLE 4: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 3 — Prioritisation

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Institutional coordination and alignment on a restoration strategy for the state which supports the strengthening of cultural and environmental repair.	• Undertake landscape scale regional planning that identifies priority areas for restoration efforts. • Develop strategies for overcoming land access and tenure constraints. • Land availability and supply analysis that incorporates mapping, modelling and viability assessment.	• Priority areas	• Where are the priority areas for ecological restoration? What are the key factors driving the weighting? • What soil types, climates, ecosystems, flora and fauna species should be prioritised? • How do we prioritise restoration to address habitat fragmentation? (e.g. which models are best in which regions?) • How do we prioritise restoration to build resilience to climate change? • Where should restoration not occur (e.g. high-quality arable land, priority areas for minerals)? • How do we consider ease of establishment/probability for success? • Can we integrate condition and threat levels? • How and where should we undertake restoration to ensure WA is achieving its 30x30 targets?	**1**
		• Data requirements	• What data do we have and what data do we need to build a state-wide restoration prioritisation? • Can we aggregate data that enables interpretation at different scales?	**2**
		• Governance and industry complementarity	• What is the most effective governance structure for the prioritisation? Who is responsible? • How do restoration priority areas intersect with existing industry operations? Can the activities be complimentary? • How do we balance benefits in competing areas? • How can ecological restoration be targeted for water catchments and salinity?	**3**

Focus Area 4: Climate resilience

Biodiversity loss and climate change mutually reinforce each other, and neither will be successfully resolved unless tackled together. Our health, living standards, cultural and spiritual fulfilment, and connection to Country are all interconnected and are negatively affected by our deteriorating environment. Almost half of Australia's gross domestic product (GDP) has a moderate to very high dependence on nature. The rate at which we are eroding the environment poses tangible risks to Australia's economic, financial and social stability. Ecological restoration is key to jointly tackling the twin environmental challenges of reducing greenhouse gas emissions while simultaneously restoring nature loss.

The opportunity that presents itself from this cascade of events, is that there are vast areas where ecological restoration could be employed to stop and even reverse the adverse impacts. We need, however, to understand the effectiveness of restoration in combating climate change, biodiversity collapse and the resilience of the restored systems. There is a need to determine the thresholds for restoring ecological systems that may be different to what was there previously in order to increase likelihood of persistence under future conditions.

TABLE 5: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 4 — Climate resilience

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Restoration is employed to mitigate the adverse impacts of climate change and biodiversity loss in Western Australia. Ecological restoration plantings are resilient to an altered landscape and climate.	• Model how ecological restoration can be used to mitigate climate change impacts. • Understand how ecosystems will shift with a changing climate and provide data to inform what to plant for resilient systems. • Revise and refine modelling of carbon sequestration potential in restorative projects.	• Restoration in a changing climate	• How will ecosystems shift in a changing climate? In what areas and ecosystems should we be considering restoring an alternate ecosystem instead of the reference? • How do we best support nature to adapt itself? • What mechanisms can be implemented to maximise success of a restored ecosystem?	1
		• Invasive species	• What will be the impact of climate change on invasive species? How will it change the populations, range, effectiveness of species? • What is the relationship between weeds/weediness, fire and a drying climate within restoration?	2
		• Fire	• What is the role/impacts of fire in restoration sites?	3
		• Water and salinity	• How can restoration be best used to support healthy water catchments and mitigate the impacts of salinity?	4
		• Supply chain	• What is the impact of climate change on seed supply/ quality? How can we manage for that?	5
		• Climate mitigation	• How can we utilise ecological restoration to mitigate the impacts of climate change in Western Australia? To what extent can it reduce threats and impacts?	6

Theme 3: Deliver

Rationale

Within the multi-faceted nature of the restoration economy, it is imperative that Western Australia has the technical knowhow of the restorative process and capability to deliver restoration-based programs at scale. While demand for restorative practices is growing, across the board there are supply chain constraints and shortages of suitably qualified people to provide advice and skills.

Focus Area 5: Workforce and enterprises

The restoration economy supports a diverse array of actors across government, industry, Indigenous Australians, research and non-profit organisations with skillsets ranging from the very technical to very applied and, as such, the pathways to employment are equally diverse. Strengthening capacity and capability will come through a multitude of pathways including but not limited to – on ground training (e.g. ranger programs), TAFE courses and higher education. Ranger programs are a key component of the restoration economy with teams providing restoration services across multiple sites in a region. However, the funding cycle for ranger programs are for two years, which limits the capacity building and long-term planning that can be achieved. The restoration economy requires a combined top-down and bottom-up approach to empower local communities, with flexible bottom-up strategies that allow communities to develop locally relevant cohorts and solutions.

The Western Australian Government recognises the significant role that the restoration economy will have in our sustainable future but there is a limited network of privately-owned businesses that provide services to the various buyers and actors investing in restorative activities. Seed and seedling supply, quality and, diversity, contractors and machinery to deliver the services are in short supply constraining the areas that can be restored each year and the species that can be returned into the systems.

Credit: Megan Hele (middle)

TABLE 6: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 5 — Workforce and enterprises

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• A restoration economy workforce that is appropriately trained and has capacity to respond to scaling restoration efforts.	• Understand and plan for a workforce capacity and expertise needed for a robust restoration economy as it matures.	• Indigenous models	• How do we help strengthen the Indigenous restoration economy? What funding and what skills are needed? • What education and upskilling pathways are accessible for Indigenous Australians? Do these enable Indigenous Australians to maintain a connection to country? What other models could be enacted? • What models are effective for a top-down and bottom-up approaches to scaling efforts? • What makes an Indigenous-led land management strategy successful (e.g. Martuwarra Fitzroy River Council) and what can we learn from these? • What are some of the successful Indigenous-led land management enterprises (e.g. Noongar Land Enterprise) and what can we learn from these?	P
		• Seed Production Areas (SPAs)	• What does the business model for SPAs look like? How do these differ for different species? • What is the expected seed demand in the future? How should this be managed through wild and SPA collections to support native ecosystems while still returning appropriate diversity? • What do different SPA models look like? (e.g. plantation, restoration sites, catchment management) and what are the challenges and benefits associated with each approach? • Are there mechanisms (e.g. offset funding) we can leverage to support SPA establishment?	1

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TABLE 6: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 5 — Workforce and enterprises (continued)

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• A restoration economy workforce that is appropriately trained and has capacity to respond to scaling restoration efforts.	• Understand and plan for a workforce capacity and expertise needed for a robust restoration economy as it matures.	• Delivery technology	• How do we engineer machinery for precision seeding to undertake restoration at scale? • How can we design and use technologies to make restoration more cost efficient and support second-passes where needed? Should we design restoration projects to plan for multiple passes? • What is the role of technology across the whole supply chain including harvesting, storage, hygiene processes, sustainability, circular economy, water efficiency etc?	2
		• Workforce capacity	• What is the required workforce capacity for the restoration economy at different scales? And what is the make-up of this workforce? • What training and skillsets are required to support the different actors in the restoration economy? • What proportion of the workforce is skilled vs unskilled labour? What are the conditions and awards currently offered? How does this compare to other sectors? • How do we attract people to the industry? And support ongoing employment? • How will artificial intelligence (AI) impact the restoration economy?	3

Focus Area 6: Restoration practice

The level of ecological recovery able to be achieved has significantly advanced in Western Australia over the past couple of decades with on ground outcomes showing the benefits of ongoing research and investment. However, there are still a multitude of challenges being faced, many of which are centred around the scaling of restoration efforts. Research questions posed in Miller et al. 2017 'A framework for the practical science necessary to restore sustainable, resilient, and biodiverse ecosystems' largely still hold and should also be considered in research programs being developed.

TABLE 7: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 6 — Restoration practice

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Restoration practitioners able to deliver restoration at scale and achieve the desired level of recovery.	• Understand the supply chain requirements for a robust restoration economy as it matures. • Adopt a policy of future practice to continually address knowledge gaps and improve on restorative outcomes.	• Reference sites	• Can we build a reference ecosystem library for the State? • Could the Western Australian Vegetation Extent (WAVE) project be further developed to include vegetation communities? And link this to key parameters to inform goals and targets? Would an alternative approach be better?	1
		• Ecosystem services & function	• How do you support the establishment of all trophic levels in a restoration project? • What factors are required to maximise ecosystem services from a restoration site?	2
		• Fauna	• How does fauna interact with restoration sites? Where and why have we seen species move into the restored area?	3

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TABLE 7: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 6 — Restoration practice (continued)

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Restoration practitioners able to deliver restoration at scale and achieve the desired level of recovery.	• Understand the supply chain requirements for a robust restoration economy as it matures. • Adopt a policy of future practice to continually address knowledge gaps and improve on restorative outcomes.	• Seeds	• How many seeds and seedlings are needed for the restoration economy at different scales? Which species are needed to be supplied? • What are the key factors in the relationship between delivery and survival? Can soil amendments (e.g. soil microbes) increase success? • Which species can't be returned via seed? What approaches are best to support those species in a restoration project? • What policy changes are needed to enable seed collection from additional areas?	4
		• Improving degraded sites	• What approaches are most effective to improve environmental condition in remnant but degraded systems? What is the effectiveness of threat management (fencing, weed management, feral management, fire regimes, plant pathogens), broadcast seeding and soil amelioration? • What can we learn from the NGO, NRM sectors and other practitioners when operating in degraded sites?	5
		• Self-recovery	• How can we support nature to repair itself? What are the foundations needed to enact a level of self-recovery?	6

Theme 4: Knowledge

Rationale

To overcome the environmental challenges faced within Western Australia, actors involved in the restoration economy will need to work in a collaborative and open way. Time and resources are finite, and the sector needs to move forward as a collective. This means sharing learnings in a logical and coordinated approach that advances the outcomes achieved. Historically, there has been a siloed approach to the understanding of restoration processes, tools and techniques; big investments dedicated to individual industries have driven specialised research projects and groups, with limited sharing of information. To move forward as a collective, these barriers need to be broken down and uniting mechanisms established within the restoration industry.

Focus Area 7: Monitoring and audit

Restoration monitoring data is irregularly collected and disparate. Where monitoring does occur, this information is not centrally stored and often lost over time. As such, Western Australia does not understand where restoration has occurred, why it was done, what it cost, what was done, and/or what has been achieved. Knowledge and data are lost resulting in rework and inefficiencies. Exceptions are the recent advances for sharing biological data like the Index of Biodiversity Surveys for Assessments (IBSA), the Dandjoo biodiveristy data platform, and pilot projects of the Shared Analytic Framework for the Environment (SAFE)[3] in Cockburn Sound and in the Pilbara.

[3] https://wabsi.org.au/our-work/projects/safe-shared-analytic-framework-for-the-environment/

Credit: Renee Young

TABLE 8: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 7 — Monitoring and audit

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Restoration projects are regularly monitored utilising a consistent approach and outcomes shared for collective learning. Data can be used to support Western Australian State of the Environment reporting and public baselines.	• Develop an effective and efficient monitoring framework that supports restoration projects with different drivers and end land-uses. • Build a repository for sharing restoration projects, approaches, monitoring outcomes, and level of recovery achieved. • Build a state-wide set of maps that can act as/provide baseline information.	• Data	• What data do we have to build state-wide baseline vegetation and ecological community and habitat maps? What additional data/ information is required? • What data to we have or need for regular state of the environment reporting? • What is the data infrastructure that supports reporting to different frameworks (e.g. TNFD, Nature Repair Market)? • What are the data requirements for the above monitoring categories and what are the methods for capture? • How could a restoration knowledge bank (data platform) be established that can amalgamate restoration approaches and outcomes (monitoring data) across industries and restoration drivers (voluntary, market-driven and regulatory/ compliance)? • How do we embed science-based reporting to avoid greenwashing? • How do we best manage the different kinds of data?	1

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Credit: Megan Hele (middle)

TABLE 8: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 7 — Monitoring and audit (continued)

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Restoration projects are regularly monitored utilising a consistent approach and outcomes shared for collective learning. Data can be used to support Western Australian State of the Environment reporting and public baselines.	• Develop an effective and efficient monitoring framework that supports restoration projects with different drivers and end land-uses. • Build a repository for sharing restoration projects, approaches, monitoring outcomes, and level of recovery achieved. • Build a state-wide set of maps that can act as/provide baseline information.	• Monitoring at different scales	• What monitoring methodologies are most appropriate for restoration projects at different scales and for different purposes? Can these be aligned? • What can we learn from the different long-term monitoring programs (e.g. EMSA)? • What is the role for remote sensing in restoration monitoring? What can be assessed with confidence? • What is the most effective way to summarise and communicate monitoring approaches? Can a standard approach be developed for different kinds of restoration?	2
		• Trajectory	• What indicators are best to track trajectories? • What are the trajectories of recovery for WA ecosystems? • What are the successional stages within a restoration project?	3
		• Levels of recovery	• What levels of recovery are currently being achieved? • What does good look like?	4
		• Species libraries	• What is the extent of spectral libraries for species? Can we build an open-source library? • What is the extent of acoustic libraries for species? Can we build an open-source library? • What is the extent of eDNA libraries for species? Can we build an open-source library?	5
		• Restoration guidelines	• What information and detail are needed in regional restoration guidelines and approaches? • What detail is needed for sector-based restoration guidelines? • How do we best embed the cultural, social, and economic benefits of ecological restoration within guidelines?	6

Focus Area 8: Extension

Effective sharing of knowledge between actors operating at different stages of an industry is a common challenge. In the restoration economy, which spans Indigenous Australians, government, carbon, mining, agriculture, infrastructure and conservation this can be even more challenging with stakeholders often not having established relationships or aligned views. Consideration on how to best share learnings and outcomes is needed to leverage the opportunity for restoration within Western Australia.

TABLE 9: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Focus Area 8 — Extension

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• An engaged cross-sector restoration industry that shares data and information from restoration projects to collectively contribute towards environmental repair and species conservation.	• Reinvigorate the extensive on-ground regional network of Landcare and NRMs to strengthen the knowledge translation and community enthusiasm for restoration. • Science communication is embedded in restoration projects.	• Knowledge exchange	• How do we best share the benefits of integrating carbon and biodiversity outcomes to land-holders? • Do we need to tailor a clear pathway for biodiversity carbon credits? • How do we promote cross-sector skill sharing between traditional owners, local farmers, and other land-care agencies to enhance mutual benefits and care for the country?	1
		• Expert knowledge	• How can we capture the knowledge and expertise of our restoration economy leaders? Who do we need to speak to?	2
		• Successful networks	• How do we demonstrate the success of the Landcare Network, particularly in the 1980s and 1990s and what would it take to reinvigorate that network today? • What are the barriers to engagement in land care and coast care programs? (e.g. age of volunteers, time, funding/ grant applications, insurance, OH&S requirements, mental health?) • Is a different model required? What would that look like? • What social, organisational, and cultural factors contribute to the formation and effectiveness of collaborative networks in ecological restoration?	3

Credit: Tranen Revegetation Systems

Part B:
Sector-based priorities

In addition to the overarching research prioritisation presented in Part A, stakeholders from individual industries and regions articulated key challenges that were largely common across actors within their respective groups (Figure 9). Knowledge gaps identified and articulated in the below are not exhaustive and represent common challenges presented by stakeholders. We note some overlap with topics captured in Part A, but duplication has been minimised where possible. Expansion of individual industry restoration economy research prioritisations may be warranted in the future.

FIGURE 9: Sectors that identified specific key challenges

Credit: Rowan Edwards (middle left) Megan Hele (bottom right)

Credit: Rowan Edwards

Carbon

The Western Australian carbon industry is a key mechanism that channels private investment into landscape restorative efforts for delivering both climate and ecological benefits. Through mechanisms such as carbon credit markets and nature-based solutions, the industry can help fund large-scale restorative actions and soil carbon improvement.

The sector is rapidly growing, but its maturity varies. While demand for high-integrity carbon credits is increasing, concerns remain about the transparency, permanence, and co-benefits of some projects. Strengthening standards, improving monitoring, and fostering genuine partnerships—especially with Traditional Owners and local communities—are essential to ensure that the carbon industry contributes meaningfully and ethically to ecological restoration.

TABLE 10: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for the carbon industry

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Carbon projects are well suited to their locations and maximise biodiversity on site.	• Projects are weighted and balance the benefits of carbon and biodiversity to obtain greatest impact for the site/region/ state.	• Impacts on local communities and Indigenous Knowledge	• What socio-economic impacts does carbon farming have on local and indigenous communities, and how can these be addressed in policy design? • How can Indigenous knowledge be integrated into biodiversity monitoring and decision-making processes in carbon farming projects?	P

(Continued following page)

Credit: Megan Hele (middle)

TABLE 10: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for the carbon industry (continued)

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Carbon projects are well suited to their locations and maximise biodiversity on site.	• Projects are weighted and balance the benefits of carbon and biodiversity to obtain greatest impact for the site/region/ state.	• Landscape and spatial planning	• How can spatial planning frameworks be optimised to quantify and integrate carbon sequestration potentials across different landscape types? • What are the trade-offs between carbon sequestration goals and other ecosystem services in multifunctional landscapes? • How can spatial planning frameworks effectively manage trade-offs between carbon sequestration goals and competing land uses? • How can urban and peri-urban landscape planning contribute to carbon sequestration and support biodiversity beyond traditional green infrastructure approaches? • To what extent can spatial planning tools (e.g., GIS, scenario modelling) effectively forecast carbon outcomes under different land-use policies? • What governance and institutional barriers limit the integration of carbon projects into landscape and spatial planning at local and regional scales? • How does the cost-effectiveness of carbon sequestration strategies vary across different spatial planning scales?	1
		• Effectiveness of carbon sequestration versus biodiversity goals	• What are the ecological trade-offs between carbon-focused land management practices and biodiversity conservation across different carbon farming models? • How do monoculture plantations established for carbon sequestration affect local species richness, habitat quality, and ecosystem resilience compared to more diverse or native ecosystem restorations? • To what extent do carbon sequestration monocultures restrict future opportunities for biodiverse ecosystem restoration by locking in land use and altering ecological baselines?	2

(Continued following page)

TABLE 10: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for the carbon industry (continued)

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Carbon projects are well suited to their locations and maximise biodiversity on site.	• Projects are weighted and balance the benefits of carbon and biodiversity to obtain greatest impact for the site/region/ state.	• Ecological impacts of different carbon farming techniques	• Which carbon farming practices and plant species combinations are most effective at simultaneously enhancing carbon sequestration and supporting biodiversity at regional scales? • How do soil-focused carbon farming techniques—such as no-till agriculture, cover cropping, and organic soil amendments—impact soil biodiversity, structure, and long-term health? • What is the current and potential effectiveness of different soil types and land uses in sequestering carbon under existing and improved management regimes? • How does soil carbon sequestration capacity vary spatially across the state, and what environmental or land-use factors drive this variability? • In what ways is climate change (e.g., warming, altered rainfall, extreme events) influencing the capacity of soils to sequester and retain carbon over time?	3

Natural Resource Management

Natural Resource Management (NRM) groups and for-purpose organisations are central to delivering on-the-ground outcomes in the restoration economy. These organisations have strong community ties, local ecological knowledge, and long-standing experience in land and water stewardship, and are as such are well positioned to lead and coordinate restoration activities that achieve lasting environmental, cultural, and social benefits.

Currently, these groups operate in a complex and evolving landscape, often navigating limited and short-term funding while responding to increasing expectations for impact and accountability. As interest in restoration grows—from government, industry, and the carbon market—NRM groups and for-purpose organisations play a critical role in ensuring that investments are grounded in local priorities, culturally appropriate, and deliver integrated outcomes across biodiversity, climate, and community well-being. Supporting their capacity and leadership is essential for a credible, inclusive, and enduring restoration economy.

TABLE 11: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for the Natural Resource Management

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• NRM groups are directing restorative actions in their catchments in collaboration with government and industry. • For-purpose organisations, community and people are valued in their role to deliver restoration and collaboration for landscape scale initiatives.	• Increased opportunities and revenue for NRM regions to have resources for management of local issues and support priority environments. • Empower and support for-purpose organisations and communities to actively participate in and lead restoration efforts, fostering collaboration and partnerships that enable inclusive, landscape-scale environmental outcomes.	• Indigenous knowledge and collaborative restoration	• How can Indigenous ecological knowledge be integrated into modern restoration practices to enhance cultural and ecological outcomes? • What are the benefits and challenges of involving local and Indigenous communities in the planning and implementation of restoration projects?	P
		• Regional planning	• How can restoration practices be tailored to different bioregions to maximise ecological recovery and resilience? • What is the prioritisation process of site selection for restoration of natural areas? • How do we effectively manage land competition and support restoration in local scale land use planning?	1

(Continued following page)

TABLE 11: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for the Natural Resource Management

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• NRM groups are directing restorative actions in their catchments in collaboration with government and industry. • For-purpose organisations, community and people are valued in their role to deliver restoration and collaboration for landscape scale initiatives.	• Increased opportunities and revenue for NRM regions to have resources for management of local issues and support priority environments. • Empower and support for-purpose organisations and communities to actively participate in and lead restoration efforts, fostering collaboration and partnerships that enable inclusive, landscape-scale environmental outcomes.	• Management of remnant vegetation	• What are the most effective strategies for restoring native ecosystems and enhancing biodiversity in degraded landscapes? • How do we manage sites that are in good condition to stop decline?	2
		• Social, cultural and economic impacts of restoration	• What are the economic benefits of ecological restoration for local communities, including the potential for job creation and sustainable land management practices? • How can the social benefits of ecosystem restoration, such as improved community wellbeing and cultural revitalisation, be measured and maximised?	3
		• Invasive species management	• What are the most efficient and sustainable methods for controlling invasive species? • Which species have the greatest impact? • How do invasive species affect the long-term success of restoration efforts?	4
		• Soil and water management in restoration	• What are the best practices for restoring soil health and water quality in degraded ecosystems, particularly in regions impacted by agriculture or mining? • How do soil amendments and erosion control techniques contribute to the success of ecosystem restoration in different landscapes?	5

Mining

The Western Australian mining sector has a long history of engaging in the practice of ecological restoration, primarily driven from regulatory requirements to return the land to a condition that is safe, stable and non-polluting, and in alignment with the agreed next use of land. Undertaking ecosystem restoration (remediation, rehabilitation, ecological restoration) in these landscapes is incredibly challenging due to the highly modified geological profile and waste landforms (e.g. waste rock dumps, tailings dams). Relinquishment is challenging to achieve, and as such, there has been considerable investment in restoration-based research. While significant advances have been made in the ability to restore some sites, there are still many barriers that face the mining sector in achieving the desired level of recovery at the scale needed.

In addition to the technical capacity to deliver restoration at the site itself, a major forthcoming issue is the need to modify mining practices to increase sustainability and reduce their impacts on nature. The International Council for Mining and Metals (ICMM) Nature Position Statement came into effect in 2024. It sets out the commitments and an approach for ICMM members to contribute to a nature positive future, guided by the Kunming-Montreal Global Biodiversity Framework (GBF) 2030 targets (ICMM 2024). The commitments start with identifying and quantifying mining impacts on nature, calculating the 'recovery gap' or 'restoration debt' and then undertaking restoration to an extent to mitigate or offset mining impacts.

TABLE 12: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for mining

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• A sustainable mining industry that understands its impacts on nature and is committed to working towards nature positive.	• Understand how to integrate nature impacts and restoration into life of mine planning with business cases to support investment into the resourcing needs (e.g. seed, personnel) to undertake restoration at scale.	• Strengthening Indigenous values and capacity	• How do we support partnership models to deliver better alignment of interests between mining companies, regulators, and Indigenous Australians? • Could shared equity models be developed where mining companies and regulators genuinely commit to restoration in partnership with Indigenous Australians, sharing risks and rewards? • Are there/could there be mechanisms for Indigenous Australians to formally endorse mine closure plans to ensure they reflect their needs and wants following site relinquishment? • How does the mining sector further support training opportunities including ranger programs?	**P**

(Continued following page)

TABLE 12: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for mining (continued)

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• A sustainable mining industry that understands its impacts on nature and is committed to working towards nature positive.	• Understand how to integrate nature impacts and restoration into life of mine planning with business cases to support investment into the resourcing needs (e.g. seed, personnel) to undertake restoration at scale.	• Quantifying impacts	• How do we quantify the impact on nature from mining in Western Australia? What are the key metrics required? • How do we best quantify the cumulative effects of the industry? How do we promote the business case for investment in CIA's? • Does NCA and/or reporting to TNFD give us the required information to plan for nature positive?	1
		• Data	• What data do we already collect? And what data/ metrics are needed to assess, plan and monitor commitments to nature positive / natural capital / disclose impacts? • Can we standardise methods of data collection across the industry? • How does mining embed natural capital accounting into business operations, and enable reporting at different scales? What would the data infrastructure look like?	2
		• Regional integration/ management	• How do we promote / manage collaboration for landscape scale restoration? • Is government-led policy required to support regional integration? What would that look like? • How do we manage the numerous barriers to success i.e. tenure, Joint venture considerations? • How do we support and advocate for existing mechanisms e.g. the PEOF to be successful (or why hasn't this been successful to date)? • How do we promote and further support communities of practice like the South West Sustainability Partnership and Pilbara Rehabilitation Group?	3

(Continued following page)

TABLE 12: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for mining (continued)

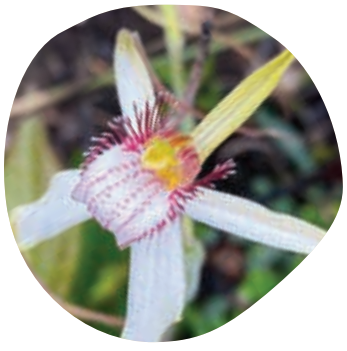
Outcome	Objectives	Knowledge gap	Example questions	Ranking
• A sustainable mining industry that understands its impacts on nature and is committed to working towards nature positive.	• Understand how to integrate nature impacts and restoration into life of mine planning with business cases to support investment into the resourcing needs (e.g. seed, personnel) to undertake restoration at scale.	• Recovery gap	• What level of recovery is being achieved and how do we assign value to the 'recovery gap'? • How do we offset the gap with restorative actions in the surrounding landscape? • What are realistic goals and targets?	4
		• Species selection	• What is the tolerance of species to grow on different landforms/ in different landscapes? • What does the hydrology look like post-mining and how does this impact the establishment of vegetation communities? • In highly modified landforms, which reference ecosystems are most appropriate to inform species selection? • Which fauna species should we be targeting to support their reintroduction post-mining and what are their requirements? • What is the most appropriate reference ecosystem? To what extent can this be restored? Or is a model ecosystem (novel) most appropriate?	5
		• Business integration	• How does mining fully integrate restoration with mine planning? What stages of restoration need to be embedded when? What is the business case for this? • How can business models be optimised to incentivise closure readiness?	6
		• Legacy sites	• What is the opportunity to undertake restoration in legacy areas? • What challenges do these sites present? And how can they be overcome?	7

Forestry

Within the restoration economy, the forestry industry includes 1) the management of native forests and 2) production of wood products through privately-owned plantations. Until recently, the south-west forests were also harvested for timber, but native logging was banned in the State in 2024. Under the new Forest Management Plan (FMP) 2024-2033, and direction of DBCA, timber will only be taken from WA's native forests for ecological thinning to maintain forest health and from approved mine site operations (Conservation and Park Commission 2023).

Ecological thinning is an adopted methodology for forest management practices in Western Australia within the FMP. The approach is also being considered in the Nature Repair Market as a component of the Native Forest Method to protect, restore and manage native forests, although the detail for this method is still being developed. Ecological thinning produced a forest that was more aligned with the Indigenous Australian understanding of a spiritually and ecologically healthy forest, however additional practice should include active and ongoing professional engagement of Indigenous Australians in forest management (archae-aus 2023). While debate is still live on the science, it appears that there will be some role for ecological thinning in managing the State's southwest forests, in terms of supporting an increased rate of return to an old growth structure and fire management.

The total plantation estate in Western Australia peaked in 2009 with 164,000 ha of hardwood and 85,000 ha of softwood plantations. Since then, the total plantation estate has been in decline. Forestry is an important part of the Western Australian economy and when strategically and appropriately integrated into agricultural systems, farm forestry can enhance farm productivity and sustainability and offer income diversity for farmers (South West Timber Hub 2024). It is increasingly being recognised that the forestry industry can also have a significant role in enhancing biodiversity and providing opportunity to engage with environmental markets.



Credit: Megan Hele (middle)

TABLE 13: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for forestry

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• A clearly articulated role for forestry within the restoration economy	• Build understanding of the risks/ benefits of employing ecological thinning as a restorative management tool. • Demonstrate how biodiversity can be considered in private plantations and contribute to nature positive outcomes.	• Traditional approaches	• What does Traditional Owner-led forest management look like and what activities should be conducted and when? • What is the role of western science in these approaches?	P
		• Monitoring	• How do we embed a cost effective monitoring program? • What have we/ can we learn from DBCA's Forestcheck program? • How do we best share this information?	1
		• Value of private plantations	• To what extent do plantations support the local biodiversity? • Are there specific actions that can be incorporated to increase biodiversity in plantations?	2
		• Ecological thinning	• What are the benefits and risks of ecological thinning? What if we do nothing? • What is the impact of ecological thinning on seed harvesting, habitat, disease movement, invasive species? • How are the sites which were ecologically thinned in the 1980s performing? • Are ecologically thinned forests more resilient to climate change? • Is ecological thinning equally appropriate across the forests? or is it more effective as a management approach in particular ecosystems? • What is the most appropriate thinning density and does this vary for different primary outcomes (e.g. water management, fire management, return of old-growth structure)? • Can the products pay for the ecological thinning management approach?	4

Infrastructure and development

Recognised as the economic arteries and veins of Western Australia, government and privately-owned utilities, transport and energy networks facilitate the critical movement of goods, services, and people. Much of Western Australia's infrastructure is ageing and requires upgrades or expansion, often triggering environmental approvals and requirements for offsets, which can be difficult to obtain in highly fragmented landscapes and in areas where vegetation communities and species are already threatened.

Associated with the infrastructure itself are, almost always, service corridors or buffer zones, which, if restored, can provide landscape connectivity, provision of habitat and enhanced ecosystem services. Targeted restoration in these areas, and surrounding landscapes, has been a focus within the infrastructure industry in recent years, but working across land manager boundaries, land access, working within the federal and state offsets frameworks, achieving appropriate levels of recovery, and understanding how to best improve vegetation condition in degraded landscapes are ongoing challenges.

TABLE 14: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for infrastructure and development

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Western Australia's infrastructure networks are valued for their connectivity and provide critical habitat and ecosystem exchanges.	• Understand the role of restoration within development and infrastructure corridors and how to improve condition to support landscape connectivity.	• Partnership models	• How does infrastructure effectively work across tenures and at multiple scales? • How do we support effective partnerships across all levels of government, business, industry and community? Can a collective impact framework be applied?	1
		• Demonstrating value	• How do we better understand economics of alternative infrastructure design solutions that clearly demonstrate the environmental values of restricted vegetation types and connectivity?	2
		• Restoration corridors	• Where should investment be targeted for greatest impact? • How do we undertake best-practice restoration in highly fragmented landscapes? • What methodologies are effective in improving condition in degraded landscapes? • What is the minimum condition needed for corridors to provide critical habitat and ecosystem services? Does this provide a good ROI?	3
		• Offsets	• What level of recovery is required for offsets?	4

Credit: Megan Hele

Pastoral Rangelands

Around 39% of Western Australia's Rangelands (87 million hectares) are under pastoral lease. The remainder consist of Unallocated Crown land (UCL), land reserved for conservation or cultural purposes, non-pastoral leasehold, and freehold. Condition and trends of the Rangelands is variable, but generally the Upper Gascoyne, Murchison, Meekatharra and Cue have the largest proportions in poor condition (DAFWA 2017). The Framework for sustainable pastoral management (Fletcher 2022) helps to ensure management of the State's pastoral estate meets the principles of ecologically sustainable development (ESD) and forms part of the Pastoral Lands Reform project initiated by the WA Government in response to the Office of the Auditor General's report, Management of pastoral lands in Western Australia (OAG 2017) which found 'the ecological sustainability of the pastoral estate was not adequately protected by the current system of monitoring and administration'.

A significant external driver for improved pastoral management over the next decade is that national and international markets are increasingly requiring individual businesses and sectors to formally demonstrate their ESG credentials to maintain a social licence to market their products. For the pastoral industry this will not only include meeting wider community expectations related to land management, but also broader environmental and animal welfare issues (Fletcher 2022).

Carbon, through the attainment of ACCUs, has been an increasing contributor to Rangelands pastoral management but following a review of the integrity of this methodology, the Clean Energy Regulator has phased out the Human Induced Regeneration methodology in September 2023 (CER 2024). A replacement methodology may emerge for the region following an EOI which was run in 2024 for new ACCU approaches. Further, a Rangelands method to manage and enhance habitat in the arid and semi-arid areas of Australia is expected to form a core part of the methodologies under the Nature Repair Market (DCCEEW, 2024b).

Management of stock, watering points, landscape rehydration and road formation are receiving increased attention as key aspects for improved environmental condition in the Rangelands.

Credit: Megan Hele (middle and right)

TABLE 15: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for Pastoral Rangelands

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Pastoral Rangelands are managed sustainably, and stations have the opportunity to engage in environmental markets to diversify income, resulting in increased environmental condition.	• Develop a suite of economically feasible approaches that can be implemented in the Rangelands to improve environmental condition.	• Methods	• What methods are most effective for improving land condition in the Rangelands? • What evidence do we have of improvement in land condition following the lowering stock rates? • What would a Nature Repair Market method look like in the Rangelands? Could it incorporate evidence beyond FullCAM (fauna recovery, etc)? • Can we leverage the ACCU Integrated Farm and Land Management (IFLM) as driver for restoration?	1
		• Invasive species	• Which invasive species should be targeted for management? Which techniques can assist in managing multiple species concurrently?	2
		• Rehydration	• What is the opportunity for landscape scale rehydration? Is there an optimal location to undertake activities? • What is the impact of the intervention at a range of scales? • How effective is brush packing as a methodology?	3
		• Roads	• How do road formation approaches alter water flow and what is the impact on the environment in the adjacent landscapes?	4

Credit: Megan Hele

Broadacre agriculture and livestock

Australia's agriculture and land sectors are already feeling the effects of climate change. The impacts are far-reaching with climate change affecting management responses, the types of production undertaken, how processing industries undertake their activities and the types of products that are processed. Decreasing rainfall, salinisation, erosion, increasing temperatures, increasing frost, fire, and pest and disease risk are all front and centre for many farmers (DAFF 2024).

Agriculture directly contributes to 14% of Australia's national emissions and as such the industry is faced with the challenge of achieving net zero (ZNE-Ag CRC 2024). The agriculture sector is investing in emission reduction strategies and considering the best ways to reduce emissions and build carbon stores. The two leading approaches being considered by farmers were promoting biodiversity with mixed species pastures and agroforestry systems (65%) and restoring degraded land and land not suitable for agriculture (60%) (Farmers for Climate Action 2023).

The proliferation of EU-based environmental, social and governance (ESG) regulation will impact Australian agriculture exposed to EU markets through their operations, supply and value chains. Further, Carbon-border adjustment mechanisms (CBAM) are being proposed by many of Australia's major trading partners, including the EU, Canada, China, Japan, the US and UK. Ultimately, Australian exporters of emissions intensive goods will be incentivised to reduce the emissions generated through production processes in order to retain EU generated revenue streams and other markets as they are introduced (CCW 2024).

TABLE 16: Outcome, objective, knowledge gaps, example questions and ranking of knowledge gaps for broadacre agriculture and livestock

Outcome	Objectives	Knowledge gap	Example questions	Ranking
• Restoration is an integral part of farming systems that enhances productivity and supports access to premium markets. Actions support biodiversity and broader environmental condition.	• Guidance on how best to integrate restoration into farming practices to optimise benefits and ROI.	• Business integration	• Where should we undertake restorative actions on farms? How does this change, depending on driver (e.g. salinity, offsets, maximising biodiversity)? • What are the trade-offs for different approaches? (e.g. effectiveness, levels of compliance, costs and sources of finances for on-going management, impact on farming operations?) • How can restoration be used to maximise agriculture yield?	1
		• Mitigating climate impacts	• How do we best integrate restoration into farming systems that maximise climate mitigation?	2
		• Market requirements	• What is the requirement to maintain market access and what would be required to access premium markets? Are these markets active?	4

5.

Restoration economy research capacity in Western Australia

Western Australia is fortunate to host a variety of dedicated researchers and research centres that have expertise in ecological restoration. To facilitate the delivery of the restoration economy research program, a high-level overview of research capability is presented on the following pages.

Credit: Megan Hele (middle)

CSIRO

Environment

CSIRO's Environment Research Unit brings together capabilities in marine, atmospheric, water and terrestrial environment disciplines, as well as significant social and economic research, to align and support the nation in creating a better and more sustainable future. Research examines the increasing pressures facing Australia's natural and built environments from the combined effects of climate change, extreme events, non-sustainable use of natural resources and legacy activities.

https://www.csiro.au/en/about/people/business-units/environment

CRC Transformations in Mining Economies

The Cooperative Research Centre Transformations in Mining Economies (CRC TiME) brings together diverse partners to help solve the challenge of mine closure and post-mine transitions. Research is focussed on overcoming barriers to mined land and infrastructure repurposing; policy and regulation, such as land tenure and pathways to relinquishment; economic diversification and transformation; enabling First Nations leadership and realisation of benefits; new ways of understanding value, such as natural capital accounting; and land rehabilitation and environmental stewardship.

https://crctime.com.au/

Curtin University

ARC Centre for Healing Country

The Australian Research Centre's Centre for Healing Country is a partnership between Curtin University, UWA and Murdoch. The Centre aims to develop cost-effective restoration solutions that can grow and strengthen Indigenous enterprises, expand and bolster diverse training pathways, and conduct innovative research to support the advancement of a diversified Indigenous-led restoration economy.

https://archealingcountry.com.au/

Native Seed Technology and Innovation Hub

The Native Seed Technology and Innovation Hub focusses on developing the most cost-effective technological solutions for seed-based restoration, ensuring that native seeds are supplied in quality, quantity, and diversity.

https://www.curtin.edu.au/news/media-release/curtin-research-to-revolutionise-land-restoration/

DBCA Biodiversity and Conservation Science

Ecosystem Science Program

The Ecosystem Science Program undertakes applied research to understand the environmental, ecological, and biogeographical processes that determine the conservation values, health and productivity of the lands and inland waters managed by the department. The program investigates broadscale threats including salinity, altered hydrology, climate change and habitat fragmentation. Projects include investigations into the nature of threats and monitoring associated ecological responses and effectiveness of mitigation strategies.

https://www.dbca.wa.gov.au/science/our-programs/ecosystem-science-program

Kings Park Science Program

The Kings Park Science Program undertakes research into native plant biology and ecology to support the conservation and management of Western Australia's unique biodiversity and ecosystems. Research focuses on key areas of ex situ germplasm conservation, restoration ecology, threatened species recovery, plant physiology, seed science, conservation genetics, ecosystem ecology, and fire ecology.

https://www.bgpa.wa.gov.au/kings-park-science

Plant Science and Herbarium Program

The Plant Science and Herbarium program conducts research to understand the factors and processes that are critical for the conservation of Western Australia's native plant diversity, including a focus on plant genomics, mitigating threats to flora and ecological communities including climate change, and practical approaches for flora recovery, including seed conservation at the Western Australian Seed Centre (Kensington), and plant translocation. The program includes the Western Australian Herbarium which among other functions provides the authoritative, permanent and physical record for the presence, distribution and names of the State's flora.

https://www.dbca.wa.gov.au/science/our-programs/plant-science-and-herbarium-program

Edith Cowan University

Conservation and Biodiversity research centre

The Centre for Conservation and Biodiversity conducts practical and applied research into the ecosystems where we live and work, specifically the wetlands, bush remnants and modified environments that form our large urban parks. The centre aims to contribute to safeguarding biodiversity, utilise cutting-edge approaches to develop insights into the underlying principles and mechanisms of species loss, and then use this to derive and apply solutions in collaboration with industry partners.

https://www.ecu.edu.au/schools/science/research/school-centres/conservation-and-biodiversity-research-centre/overview

Murdoch University

Centre for Sustainable Farming Systems

The Centre for Sustainable Farming Systems works to increase farm productivity without further degrading water, land and soils. Addressing the challenges posed by climate change and increasing human population, the centre's research focuses on optimising crop production in rotation with legume pastures, and increasing biological nitrogen fixation while minimising impact on the environment.

https://www.murdoch.edu.au/research/ffi/centres/centre-for-sustainable-farming-systems

Harry Butler Institute (HBI) Centre for Terrestrial Ecosystem Science and Sustainability

Located within the Harry Butler Institute, the Centre for Terrestrial Ecosystem Science and Sustainability represents a collaboration of academic research staff working with community, industry and management partners towards a shared vision of maintaining sustainable and biodiverse ecosystems through scientific excellence.

https://www.murdoch.edu.au/research/hbi/centres/centre-for-terrestrial-ecosystem-science-and-sustainability

UWA

Centre for Environmental Economics and Policy (CEEP)

The UWA CEEP undertakes multidisciplinary research that encompasses issues in environmental policy. Utilising a range of tools such as optimisation, statistics, social surveys, benefit: cost analysis, project evaluation, bio-economic models, non-market valuation, and decision support tools, they integrate information from physical sciences, biology, and social sciences within an economic framework.

https://www.uwaceep.org/

Centre for Engineering Innovation: Agriculture & Ecological Restoration (CEI:AgER)

The CEI:AgER aims to enhance the social value, economic value, and sustainability of agricultural and environmental resources, with practicality, commercialisation, and easy adoption in mind by providing engineering solutions and methodologies for agricultural prosperity and ecological restoration.

https://www.uwa-cei.org/

NESP Resilient Landscapes

The Resilient Landscapes Hub is hosted by UWA and working collaboratively with the Department of Climate Change, Energy, the Environment and Water (DCCEEW), along with a range of other research users. The Hub is aiming to deliver science that will improve the management of Australia's terrestrial and freshwater ecosystems and make them more resilient to extreme events and pervasive pressures.

https://nesplandscapes.edu.au/

6.

Mapping research capacity with identified themes and key industries

Effective implementation of research programs will require not only an understanding of the research capacity in Western Australia, but also the kinds of research being undertaken by academic research (Table 17) and applied research (Table 18) organisations and how this can be leveraged for greater outcomes. In this section we map, to the best of our ability, the key research groups and other organisations undertaking applied research within the restoration economy.

Organisations are mapped to the priority themes and key industries identified in the research prioritisation. Please note this list is not exhaustive. Due to the transient nature of this field, when building research programs a separate stakeholder analysis should be undertaken.

Credit: Renee Young

TABLE 17: Academic research organisations undertaking work (✓) to support the restoration economy and alignment to priority themes and industries

Organisation	Purpose		Plan		Deliver		Knowledge	
	Benefits	Markets and compliance	Prioritisation	Resilience	Workforce and enterprises	Restoration practice	Monitoring and audit	Extension
CSIRO – Environment	✓	✓		✓		✓	✓	
CRC Transformations in Mining Economies		✓		✓	✓			
Curtin – Healing Country	✓				✓	✓		
Curtin – Seed Innovation Hub					✓	✓		
DBCA – Ecosystem Science							✓	
DBCA – Kings Park Science			✓	✓		✓		
DBCA – Plant Science and Herbarium						✓		
ECU – Conservation and Biodiversity				✓		✓		
Murdoch – Centre for Sustainable Farming Systems		✓		✓				
Murdoch HBI – Terrestrial Ecosystems and Sustainability		✓		✓		✓	✓	
UWA – CEEP	✓	✓						
UWA – CEI:AgER					✓	✓		
UWA NESP – Resilient Landscapes			✓	✓			✓	

(Continued following page)

TABLE 17: Academic research organisations undertaking work (✓) to support the restoration economy and alignment to priority themes and industries (continued)

Organisation	Sector						
	Carbon	Natural Resource management	Mining	Forestry	Infrastructure and development	Pastoral Rangelands	Broadacre agriculture and livestock
CSIRO – Environment	✓	✓	✓	✓			
CRC Transformations in Mining Economies	✓	✓	✓				
Curtin – Healing Country					✓		
Curtin – Seed Innovation Hub	✓	✓	✓		✓		
DBCA – Ecosystem Science				✓			
DBCA – Kings Park Science			✓				✓
DBCA – Plant Science and Herbarium							
ECU – Conservation and Biodiversity							
Murdoch – Centre for Sustainable Farming Systems				✓			✓
Murdoch HBI – Terrestrial Ecosystems and Sustainability	✓	✓	✓				✓
UWA – CEEP	✓	✓				✓	✓
UWA – CEI:AgER							
UWA NESP – Resilient Landscapes	✓	✓					

TABLE 18: Applied research organisations undertaking work (✓) to support the restoration economy and alignment to priority themes and industries

Organisation	Purpose		Plan		Deliver		Knowledge	
	Benefits	Markets and compliance	Prioritisation	Resilience	Workforce and enterprises	Restoration practice	Monitoring and audit	Extension
Aboriginal Rangers Program	✓			✓	✓		✓	✓
Australian Network for Plant Conservation								✓
Australian Wildlife Conservancy		✓					✓	✓
Bush Heritage Australia	✓		✓	✓		✓	✓	✓
Carbon Neutral	✓	✓	✓		✓	✓	✓	
Carbon Positive Australia	✓				✓	✓	✓	
Gondwana Link	✓				✓	✓	✓	✓
Greening Australia	✓				✓	✓	✓	✓
Indigenous Desert Alliance	✓			✓	✓		✓	✓
Kimberly Land Council	✓				✓			✓
Landcare WA	✓							✓
Northern Agricultural Catchment Council			✓			✓	✓	✓
Perth NRM		✓	✓	✓		✓	✓	
Rangelands NRM			✓			✓	✓	✓
Restoration Decade Alliance			✓					✓
RIAWA						✓		✓
South Coast NRM		✓	✓			✓	✓	✓
South West NRM			✓			✓	✓	✓
WABSI	✓	✓	✓					✓
Wheatbelt NRM			✓			✓	✓	✓

(Continued following page)

TABLE 18: Applied research organisations undertaking work (✓) to support the restoration economy and alignment to priority themes and industries (continued)

Organisation	Sector						
	Carbon	Natural Resource management	Mining	Forestry	Infrastructure and development	Pastoral Rangelands	Broadacre agriculture and livestock
Aboriginal Rangers Program		✓					
Australian Network for Plant Conservation		✓		✓	✓	✓	✓
Australian Wildlife Conservancy							
Bush Heritage Australia							
Carbon Neutral	✓	✓					✓
Carbon Positive Australia	✓	✓					
Gondwana Link		✓					
Greening Australia	✓						✓
Indigenous Desert Alliance		✓					
Kimberly Land Council		✓					
Landcare WA		✓					✓
Northern Agricultural Catchment Council				✓			
Perth NRM		✓					✓
Rangelands NRM	✓	✓	✓			✓	
Restoration Decade Alliance							
RIAWA							
South Coast NRM							✓
South West NRM							✓
WABSI		✓		✓	✓	✓	
Wheatbelt NRM							✓

7.

Research program implementation

Western Australia urgently requires the tools and knowledge to scale restoration and improve the level of recovery being achieved. The restoration economy research prioritisation framework highlights key areas to direct investment to achieve impact and overcome knowledge barriers preventing the scaling of the restoration economy. A funding strategy will need to be diverse and malleable to tackle multiple issues concurrently and pool outcomes to maximise a collective approach.

Credit: Megan Hele (right)

Funding strategy

ARC Linkage projects

The Australian Research Council (ARC) Linkage Projects scheme promotes collaboration and research partnerships between key end users in research and innovation including higher education institutions, government, business, industry and end users. Research and development are undertaken to apply advanced knowledge to problems, acquire new knowledge and as a basis for securing commercial and other benefits of research. The Linkage Projects scheme provides funding to eligible organisations (higher education institutions) to support research and development projects which are collaborative, are undertaken to acquire new knowledge and involve innovation. The Linkage Projects scheme provides project funding of A$50,000 to A$300,000 per year for two to five years.

Carbon Farming and Land Restoration Program

The Western Australian Carbon Farming and Land Restoration Program is a key component of the State Climate Policy. Its goal is to harness agriculture's capacity to sequester carbon across the landscape, produce WA-based carbon credits, and foster the development of the carbon farming sector by offering education, outreach, and financial support. The Program offers financial aid for carbon farming projects that generate Australian Carbon Credit Units (ACCUs) and achieve one or more of its five priority benefits: biodiversity and conservation, agricultural productivity, soil health, salinity mitigation, and/or Aboriginal economic and cultural outcomes.

Cooperative Research Centres Projects (CRC-P)

CRC-P grants support short-term (up to 3 years) industry-led partnerships to develop new technologies, products and services that will solve problems for industry and deliver tangible outcomes. At least one of the two required industry partners must be a small to medium business enterprise (SME: up to 200 employees). At least one research organisation is required to complete the partnership. CRC-Ps must also demonstrate education and training opportunities between industry and research partners. Aligning project outcomes with strategic priorities identified through relevant Growth Centres is also encouraged.

A maximum of $3 million in funding from the Australian Government is available for each CRC-P. All partners in a CRC-P must contribute resources, with the total contribution including cash and in-kind matching the amount requested from the CRC Program. The matching resources can be cash or in kind, but cash contributions, particularly from industry, will be viewed favourably. One of the clear advantages of a CRC-P includes the ability to leverage industry funds with Government and other funders.

Direct or pooled industry investment

Direct or pooled industry investment presents a significant opportunity to support restoration at scale and restoration research in Western Australia. Often able to be tailored to address immediate needs and be delivered in a timely manner, direct investment can offer a simpler path to overcome knowledge barriers. As industries are increasingly held accountable for their environmental footprints, these investments not only offer potential financial returns but also help companies align with sustainability goals, fulfill corporate social responsibility commitments, and contribute to biodiversity conservation.

Impact investment

Impact investments are investments made into organisations, projects or funds with the intention of generating measurable social and environmental outcomes, alongside a financial return. Often made directly into an organisation or via a managed impact investment fund, they typically come in the form of a loan (debt) or a private stake in an entity (equity) and span different asset classes. Impact investments are often directed towards on-ground projects but can also be used for research to develop innovative solutions, technologies, or practices to overcome key challenges.

National Environmental Science Program (NESP)

The National Environmental Science Program Phase 2 (NESP2) provided A$149 million between 2021 to 2027 of which A$47 million has been allocated to the Resilient Landscapes Hub. This hub, led by Professor Michael Douglas of The University of Western Australia, will provide research to inform management of Australia's terrestrial and freshwater habitats to promote resilience, sustainability and productive practices.

Philanthropy and strategic alliances

Collaborative alliances with land managers linked to NGOs or philanthropic partnerships are an option for co-investing in complementary research. Not-for-profit groups such as Greening Australia, Gondwana Link, Australian Wildlife Conservancy, Bush Heritage Australia and, Indigenous ranger groups, all present well-aligned collaborative options in this regard.

Credit: Renee Young

Governance

The successful delivery of prioritised research is dependent on an appropriate governance structure. The WABSI research program development pathway builds in the establishment of a steering committee to deliver prioritised programs. A steering committee comprises key stakeholders, researchers and at least one representative from the regulatory sector, ensuring outcomes are consistent with policy objectives. For this program, whilst WABSI will provide project support, it is an independent steering committee that will deliver prioritised research.

The primary role of a steering committee that will guide the implementation of the research program is to:

- drive project development, ensuring projects are well integrated and aligned with the research prioritisation to achieve outcomes;
- pursue relevant funding opportunities for prioritised projects;
- assist in the scoping of projects and ensure intended outcomes meet the requirements of end users;
- ensure the science being delivered is of a high standard without duplication of research effort;
- ensure outcomes are able to be translated effectively to all end users of the knowledge to encourage adoption of research findings;
- maintain the research program plan, ensuring it is up to date and best reflects the current end user needs and research capability; and
- align activities to relevant state and Commonwealth objectives.

Conclusion

Ecological restoration is central to combatting the interconnected climate and biodiversity crises. Reaching global nature positive goals—by halting and reversing the decline of species and ecosystems—is crucial for sustaining healthy economies, resilient livelihoods, and overall human wellbeing.

The Western Australian restoration economy is currently experiencing growth, with expectations for increased demand, scale, and complexity in restorative projects. Building a robust restoration economy requires a coordinated strategy involving government, NGOs, business, philanthropy, education, practitioners, and landowners.

Credit: Threshold Environmental

Recognising the urgency and complexity, WABSI initiated a research prioritisation process, aimed at identifying critical knowledge gaps to inform future investment. Developed through an iterative process engaging diverse stakeholders including end users and researchers via surveys, consultations, and workshops, the resulting framework presents priorities in two parts: overarching strategic issues impacting the state-wide economy (purpose, plan, deliver, knowledge) and specific challenges within key sectors such as carbon, mining and natural resource management. A central priority identified across themes is supporting Indigenous Australians in the restoration economy to help heal Country.

Addressing the knowledge gaps identified in this prioritisation is central for enabling the Western Australian restoration economy and increasing the scale, quality, and effectiveness of restoration efforts. The highest priority areas for targeted research were found to be understanding and valuing the benefits of restoration, improving prioritising and coordinating restoration efforts across the state, and establishing consistent monitoring & audit processes for restoration projects. Implementing this research program with an effective governance structure, such as a dedicated steering committee, and securing significant, diverse funding is key to scaling restoration efforts in Western Australia. By fostering collaboration, aligning with existing initiatives, and ensuring research outcomes are translated effectively to end users, this program provides a pathway to maximise the adoption of new knowledge and transform the report's findings into tangible, on-ground environmental, social, and economic impact across Western Australia.

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Credit: Megan Hele (middle and right)

Appendix 1.

Contributing stakeholders

- Ag&Eco
- Alcoa
- Apace WA
- Arjaway
- BHP
- Bush Heritage Australia
- Carbon Neutral
- Carbon Positive
- Carbon Sync
- CBH
- Conservation Council of Western Australia
- CSIRO
- Curtin University
- Daniel Garlett
- Department of Biodiversity, Conservation and Attractions (DBCA)
- Department of Energy, Mines, Industry Regulation and Safety (DEMIRS)
- Department of Primary Industries and Regional Development (DPIRD)
- Department of Water and Environmental Regulation (DWER)
- Dilji Group Holdings | Kado Muir Pty Ltd
- Edith Cowan University
- Gelganyem Ltd
- Gondwana Link
- Greening Australia
- Hanson Construction Materials
- ITTC for Healing Country
- Iluka
- Inpex
- Infrastructure Sustainability Council
- Landcare WA
- Main Roads Western Australia
- Mattiske Consulting
- Mineral Resources
- Murdoch University
- Northern Agricultural Catchments Council
- Notre Dame University
- NRM WA
- Perth NRM
- PF Olsen
- Plantrite
- Rangelands NRM
- Roy Hill
- Rio Tinto
- Savior Consulting
- South Coast NRM
- Society for Ecological Restoration Australasia
- Soil and Land Conservation Council
- Stantec
- Syrinx Environmental
- Threshold Environmental
- Tranen Revegetation Systems
- Umwelt Environmental and Social Consultants
- University of Melbourne
- University of Western Australia
- WA Agricultural Research Collaboration (WAARC)
- Water Corporation
- Wespine
- Wheatbelt NRM
- Yued Aboriginal Corporation

Appendix 2.

Summary of the 2022 Western Australian Restoration economy (WARE) project

The 2022 Western Australian restoration economy (WARE)[4] project aimed to assess the scope and scale of the restoration economy in Western Australia. To this end, WABSI conducted a market-based assessment and gap analysis, resulting in a draft roadmap designed to enhance the state's capacity to deliver effective, large-scale ecological restoration, both individually and collectively.

The WARE framework was organised into four key components: drivers, inputs, restoration activities, and outputs. The supply chain in Western Australia was categorised into 'buyers' and 'providers'. Buyers encompass businesses, organisations, and government agencies involved in urban, agricultural, carbon, and mining restoration projects, while providers include consultants, suppliers, and researchers who deliver restoration services.

A survey was sent to 544 key stakeholders involved in WARE, achieving a 12.5% response rate. In the 2020/2021 financial year, expenditure on restoration was AU$69.6 million, with activities conducted across 35,817 hectares of land. The survey identified 774 individuals employed in restoration-related roles across the surveyed companies and organisations. By cautiously extrapolating these results, we estimate the annual size of the WARE at AU$720 million, supporting approximately 5,100 jobs, assuming the average values are representative of the broader industry. This estimate is likely a conservative lower bound of the sector's economic contribution, as the survey faced limitations in identifying all relevant groups and gathering comprehensive data.

Most sectors within the WARE are experiencing growth, with the most notable expansion seen in carbon farming and restoration companies. However, the restoration industry faces significant challenges, including policy barriers, issues with land, seed and equipment supply, capacity and capability.

The report highlights three key areas for advancing the WARE: expand, deliver, and inform. Central to optimising the potential of the WARE are research, data, and digital tools and technologies. These findings should guide governance structures (including leadership, policy, and regulation) and support capacity building (through financial investment, education, training, and improving quality and supply). For the restoration economy to become robust and sustainable, it must be recognised as a distinct industry with dedicated strategies supporting all stakeholders. Given the WARE's complex nature, developing these strategies will require collaboration among government agencies, industry, and researchers.

The role of WABSI is to focus on a coordinated approach to addressing knowledge gaps arising from end user needs. As such, it was identified that there was a need for a dedicated prioritised research plan, focused on addressing end user priorities.

[4] The Western Australian Restoration Economy https://wabsi.org.au/wp-content/uploads/2023/11/WA-Restoration-Economy-Report-2-2.pdf

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