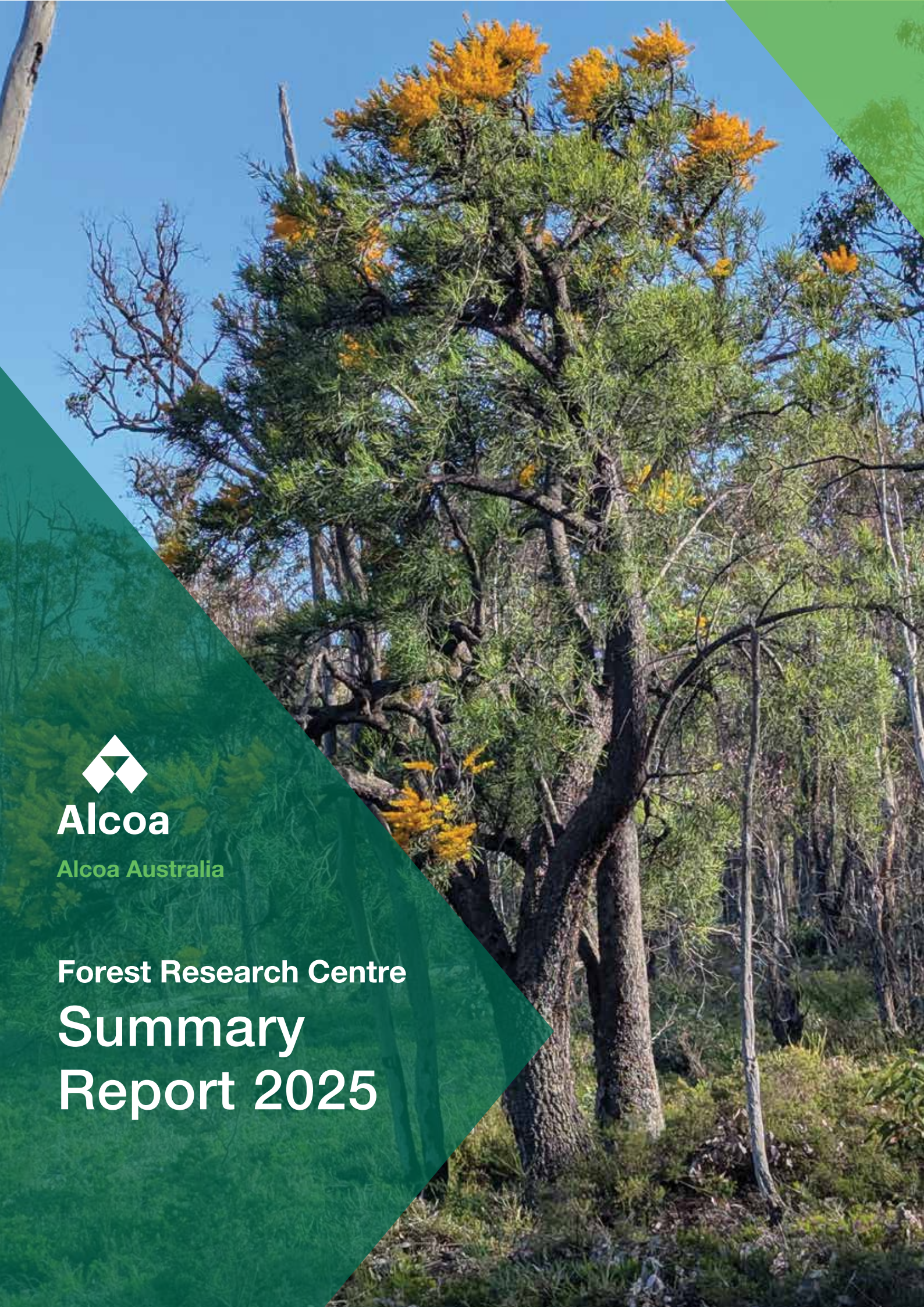

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## Forest Research Centre

# Summary Report 2025

# Contents



## Acknowledgement of Country

The Forest Research Centre acknowledges the Noongar people as the Traditional Owners and Custodians of the land on which our Centre operates. We recognise, acknowledge, and honour their ongoing connection to Country and the vital role of Indigenous knowledge in caring for landscapes and ecosystems that have been sustained for thousands of years. We pay our respects to Elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples.

*COLOURS OF THE SEASONS by Bindjareb Noongar artist Gloria Kearing*

# Executive summary

Alcoa Australia's Forest Research Centre (FRC) commenced operations at the beginning of 2025. The aim was to establish an applied research function to deliver science-based insights supporting mine rehabilitation, biodiversity conservation, water stewardship, and the integration of First Nations knowledge across Alcoa's Western Australian operations.

Guided by a research plan co-designed with research users, and a robust governance framework, the FRC is developing an ambitious portfolio of research to support operational decision making and long-term stewardship of the areas where Alcoa operates.

Across five interconnected pillars, the FRC progressed 15 ongoing projects, initiated 17 new projects, and completed five major studies in 2025.

Supported by strong internal and external collaborations, enhanced infrastructure, and a multidisciplinary team that grew throughout the past year to 10 staff, the FRC demonstrated the value of targeted, collaborative research in addressing complex environmental challenges.

These outcomes position the FRC to further strengthen rehabilitation practice and deliver enduring environmental and cultural benefits in 2026 and beyond.

# Guiding principles

**Scientific Excellence:**
Conducting rigorous, peer-reviewed research.

**Collaboration:**
Fostering partnerships with researchers, industry, government, and First Nations communities.

**Innovation:**
Embracing new technologies and approaches to research and rehabilitation.

**Sustainability:**
Promoting environmentally and socially responsible forest management.

**Cultural Respect:**
Integrating First Nations' cultural values and traditional ecological knowledge.

**Impact:**
Ensuring research outcomes are translated into practical applications and policy.

## 2025 snapshot

**17**
New projects

**15**
Ongoing projects

**5**
Completed projects

**3**
Alcoa co-authored publications

**2**
Thesis submissions

**2**
Alcoa supported publications

**130+**
Annual symposium attendees

**18**
Presentations and talks

**10**
Site tours and visits

**16**
Research Partner Organisations

**48**
External stakeholder meetings

**36**
External stakeholders engaged

**18**
Internal client teams

**5**
New staff

**1**
Major facilities refurbishment

# Research pillars

### First Nations Two-Way Science

Partnering to underpin and enhance understanding of overall forest management, fire, culturally significant species, and health and wellbeing benefits found in the forest.

### Enhancing Forest Flora Knowledge

Developing knowledge of rehabilitated ecosystems, ecological communities, and impacts of climate, fire and dieback on forest plants.

### Water Stewardship

Ongoing protection of waterways and drinking water catchments, and furthering research of long-term trends in stream flow and climate impacts on surface and groundwater.


### Leading Practice Rehabilitation

Building understanding of landscaping practice, topsoil management, seed germination and growth, and plant cultivation.

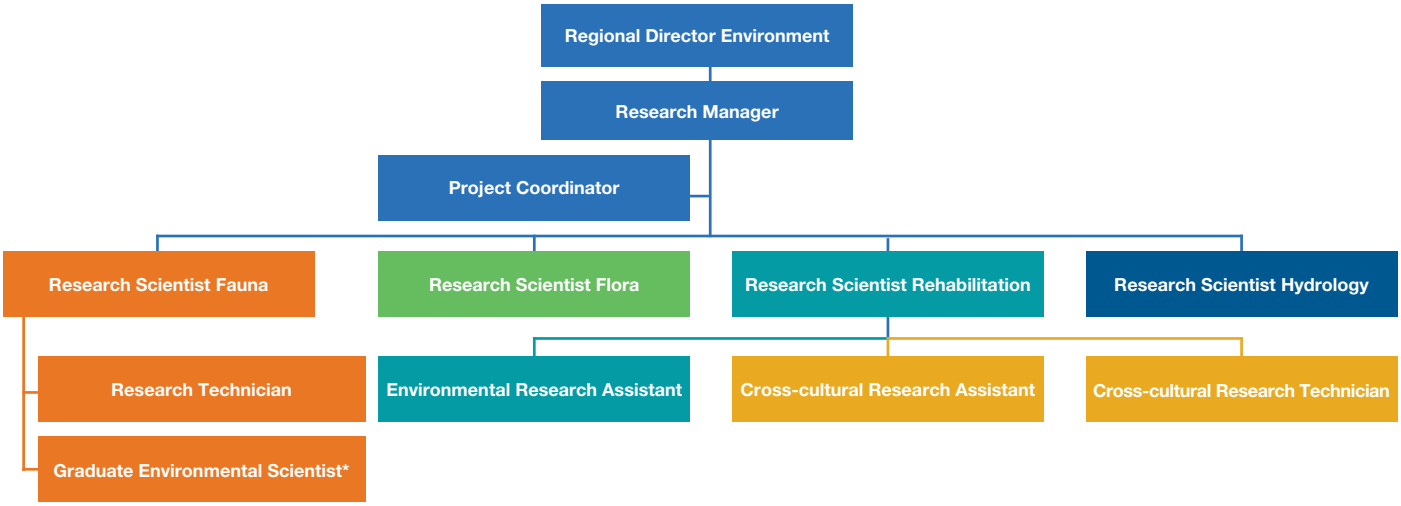
### Fauna Protection and Return

Understanding and enhancing fauna management through improved surveys and monitoring, use of technology and feral species control.

# Staff/structure

The FRC operates as part of the Regional Environment Team, with a Research Manager who reports to the Regional Director of Environment. In 2025, five new staff joined the multi-disciplinary team. The centre brings together professionals with diverse backgrounds and expertise dedicated to applied science.

An internal steering committee helps to provide strategic oversight and set research priorities, while an independent technical advisory committee supports the quality, credibility, and relevance of the FRC's work.



# Research planning

Research priorities are co-designed through engagement with internal research users, Traditional Owners, external stakeholders, and research partners.

Governance is provided through the FRC's Steering Committee and Technical Advisory committee, ensuring alignment with operational needs, regulatory expectations, and scientific best practice.

Commencing in November 2024, a co-design approach with Alcoa research end-users identified short to medium-term knowledge and technology needs. Requests were gathered via an open call, by collating ideas recorded from across the business throughout the year, and through a co-design workshop at the Australian Alcoa Environmental Professionals Forum. This resulted in 186 requests that were consolidated into 55 challenges, categorised under the FRC pillars, each with respective areas of interest, then prioritised using a risk matrix.

Proposed research projects were then mapped against these priorities to identify gaps. Funding and/or staff resource allocation were determined based on priority.

Further information on the co-design and prioritisation is available in the 2025 Research Plan.

## PILLARS

### First Nations Two-Way Science

AREAS OF INTEREST

- Indigenous biocultural knowledge
- Culturally significant entities

### Enhancing Forest Flora Knowledge

- Community ecology
- Functional traits
- Vegetation mapping
- Ecosystem resilience
- Long-term trajectories
- Fire ecology

### Leading Practice Rehabilitation

- Landscaping practices
- Soil development
- Topsoil management
- Seed sourcing and germination
- Plant survival and health

### Water Stewardship

- Long-term trends
- Surface and groundwater
- Plant-water interactions
- Impacts of changing rainfall patterns

### Fauna Protection & Return

- Habitat preferences
- Return to rehabilitation
- Populations dynamics
- Behavioural ecology
- Feral species control

# Pillar overview: First Nations Two-Way Science

The First Nations Two-Way Science pillar is grounded in genuine partnership and reciprocal knowledge sharing with Indigenous communities.

Current research focuses on two key themes: Indigenous biocultural knowledge (which includes traditional forest management practices, the role of fire in healthy ecosystems, the cultural and ecological significance of key species), and Culturally Significant Entities (which emphasise the connection between forest health and Indigenous practices and wellbeing).

Four key tasks were initiated in 2025. The first was a literature review on Noongar biocultural knowledge, focusing on traditional management of flora, fauna, fire, and cultural connections to the landscape. This review will help identify species of cultural significance and Noongar strategies for managing the Northern Jarrah Forest (NJF). The second task was to develop ethical, culturally safe, and inclusive protocols for co-designing research projects. These two steps led to the third and fourth milestones: establishing a first approach to collaborative work with the Gnaala Karla Booja (GKB) Aboriginal Corporation and signing the first joint project with Curtin University and GKB on Cultural Entities in the NJF.

### Key Activities:

- Commenced a literature review to identify culturally significant species and traditional landscape management practices in the NJF
- Developed ethical, culturally safe protocols to guide co-design of research proposals in partnership with Traditional Owners
- Strengthened internal capacity for culturally informed research design and engagement
- Commenced Indigenous-led research on Culturally Significant Entities with Curtin University and Gnaala Karla Booja Aboriginal Corporation

### CASE STUDY

**Noongar management of NJF: Indigenous Biocultural Knowledge (IBK) – literature review**

The Noongar people, as Traditional Owners of the land, have carefully managed the forests, waterways, and biodiversity of this area for tens of thousands of years.

Their longstanding stewardship has given rise to a rich body of ecological knowledge, and, in recent years, international and national conservation policies have increasingly led to the inclusion of Indigenous peoples and their knowledge in environmental management.

The potential contribution of Indigenous knowledge to contemporary ecosystem science and management is widely acknowledged.

Therefore, IBK has been increasingly recognised as a vital resource for effective ecosystem management. The aim of this project is to develop a comprehensive literature review for the creation of species and reference databases to identify culturally significant flora, fauna, and traditional land management within the NJF.

Online and physical resources will be consulted to include as many references as possible. Findings will be summarised in a memo covering the main topics (flora, fauna, fire, culture) to inform Alcoa staff about biocultural knowledge and traditional management of the landscape.

# Pillar overview: Enhancing Forest Flora Knowledge

This pillar is focused on the development and resilience of forest and rehabilitated ecosystems, examining how climate change, fire regimes, and dieback affect native plant communities.

It studies the long-term trajectories of these sites to understand their ability to sustain healthy, functioning ecosystems and adapt to climate-related challenges.

Insights from this research are intended to guide restoration practices that ensure rehabilitated areas thrive under changing conditions. The pillar is organised around three key themes: Northern Jarrah Forest community ecology, resilience of ecosystems, and long-term trajectories.

### Key Activities:

- Commenced Australian Research Council (ARC) Linkage project research on community completeness as a restoration metric
- Progressed fire recovery studies comparing areas under rehabilitation and unmined forest
- Advanced dark diversity and functional trait analyses to better understand plant communities in areas under rehabilitation and unmined forest

## CASE STUDY

### Ecological impacts and recovery trajectories of fire in rehabilitated areas and forest ecosystems

Both planned and unplanned fires occur in the Northern Jarrah Forest. Plants have various adaptations that enable them to be resilient to, i.e. bounce back from, fire. This project is investigating how plant communities recover after fire in areas under rehabilitation compared with unmined forest. We aim to better understand how fire affects species richness, the fire response strategies of different species, and the recovery trajectory over time. To do this, we are currently monitoring a network of recently burnt, unburnt, and soon to be burnt sites, recording abundance and cover of all plant species. So far, we have completed monitoring over the past two years. Early results show that species richness increases immediately following fire, that many plants use more flexible recovery strategies than previously thought, and what this means for long-term forest resilience and restoration planning.

# Pillar overview: Leading Practice Rehabilitation

The Rehabilitation research pillar achieved substantial progress across its core research themes in 2025, building on both newly initiated work and several ongoing research projects established in previous years.

Advancements were made in landscaping practices, erosion control, topsoil management, seed science and plant establishment. Multiple new field trials were installed at Huntly and Willowdale, while existing long-term studies continued to generate valuable findings. Several projects reached completion, and several others progressed to the monitoring phase for 2026. Foundational research on soil structure, water dynamics, seed viability and germination biology continued to strengthen the evidence base that underpins rehabilitation decision making. Collaboration with universities, government agencies and industry partners remained a key focus throughout the year.

### Key Activities:

- Four projects were completed, including development of the contour ripping audit tool, completion of Phase 1 of the Climate Adapted Seed Sourcing Project (which has a field trial at Willowdale), the *Hibbertia* Seed Dormancy and Germination PhD project, and the 2023 Willowdale Direct Return Topsoil and Seeding Trial.
- Nine new projects and field trials were initiated or installed, including ripping trials, seed bank research, fertiliser optimisation, topsoil quality, seed germination, and updated seed mixes.
- Two projects are scheduled to commence in early 2026 on soil health monitoring and transplanting ancient grasstrees, pending finalisation of contracting.

### CASE STUDY

**Ecophysiology of seed dormancy and germination of *Hibbertia* to inform seed propagation for ecological restoration**

The jarrah forest is a globally recognised biodiversity hotspot, but return of some understorey species is challenging.

This includes *Hibbertia* species which often produce seeds that are difficult to germinate. This project sought to understand how the complex seed dormancy of *Hibbertia* species worked and to identify treatments to improve germination.

Seeds from 10 *Hibbertia* species were collected and tested for responses to natural seasonal cues, smoke chemicals, temperature, moisture, and soil burial in both laboratory and field settings.

We found that all species have a form of morphophysiological dormancy that requires cool winter conditions and fire related signals

- especially smoke compounds - to germinate, and that natural seasonal cycles triggered germination more effectively than any laboratory treatment.

The findings provide clear, species-specific guidance including early season sowing and smoke-based pre-treatments to improve the restoration success of *Hibbertia* in post-mining rehabilitation.

# Pillar overview: Water Stewardship

Water research focuses on protecting waterways and drinking water catchments by analysing long-term streamflow trends and assessing the impacts of climate change on both surface water and groundwater systems.

This includes investigating groundwater-surface water interactions to better understand how these connected systems respond to environmental change. By strengthening knowledge of these dynamics, the research supports sustainable water resource management and enhances the resilience of water supply systems. Through evidence-based analysis, water research will guide proactive planning for future water security, helping identify cumulative catchment risk assessment and supporting adaptive responses to emerging challenges. The water stewardship pillar currently focuses the research in one main theme: Monitoring, Hydrologic and Hydrogeological Regime, Erosion and Turbidity.

### Key Activities:

- Commenced regional application of the GR8J rainfall-runoff model to inform forest catchment management in a drying climate
- Commenced collaborative project with the University of Western Australia: 'How do regolith and tree density influence canopy resilience of native and rehabilitated jarrah forest to heat and drought?'
- Proposed catchment-scale monitoring, groundwater-surface water interactions, hydrological modelling (to predict soil, water, sediments and turbidity dynamics over life of mine), catchment yield and ground water dependent vegetation
- Integrated hydrological and forest management planning

### CASE STUDY

**Pilot desktop analysis of forest canopy health and drought vulnerability**

This desktop assessment was designed to establish a foundation for understanding how forest canopy health and drought vulnerability are influenced by various factors.

Looking at both native jarrah forest and post mining rehabilitation areas, the assessment looked specifically at regolith depth, stem density and their interactions. The study compiles existing datasets, including LiDAR, geophysics, borehole logs, forest plots, climate data and vegetation condition layers, to identify suitable intensively monitored sites. These sites will support the exploration of links between canopy condition, forest structure and subsurface characteristics at multiple spatial scales. The project will also examine how regolith depth and pre-drought forest condition shaped regional responses during recent drought events, including the hot and dry summer of 2023 to 2024. Several analytical approaches will be tested to determine the most suitable framework for predicting forest condition and drought response. Findings will guide Alcoa in rehabilitation design, thinning decisions and future research directions.

# Pillar overview: Fauna Protection and Return

This research pillar takes a holistic approach to fauna management, focusing on two key themes: native species and feral species.

Priorities include improving survey and monitoring techniques, using advanced technologies for better data collection and analysis, and implementing best-practice feral species control strategies. The aim is to deepen understanding of native fauna populations, their ecological roles, and threats, enabling informed decisions that support long-term protection and recovery of vulnerable species.

During 2025, the fauna research team focused on threatened species and short-range endemics, as well as threats to threatened species and fauna use of areas under rehabilitation. We continued our research on black cockatoos, finished a project on feral cats and commenced a project tracking chuditch.

### Key Activities:

- Tracked chuditch throughout Huntly mine using GPS collars to understand movement ecology. 39 individual chuditch were captured, 28 fitted with collars, and a total of 46 collaring events over four seasons. One chuditch raised her young in an area under rehabilitation
- Continued to monitor the extent of quokka populations across Huntly mine
- Analysed how Black Cockatoos use retained nest trees on site

## CASE STUDY

### Predator in the patchwork: Examining how chuditch navigate a post-mining landscape

In 2025 we conducted a study using GPS collars to track chuditch across a post mining landscape with a mosaic of disturbance histories. This is the first time GPS technology has been used for this species, allowing us to collect fine scale movement data far beyond what was possible with previous VHF based studies.

Over 12 months, up to 14 individuals per season were fitted with custom GPS collars, providing detailed information on habitat use, home range size, den selection, seasonal behaviour, and sex based differences. We also located daytime dens via VHF tracking and collected microclimate and habitat data for each site.

Preliminary results show chuditch are highly adaptable, with home ranges far larger than earlier estimates — over three times larger for females and nearly 15 times larger for males — and regular use of both remnant forest and areas under rehabilitation.

Individuals moved through active mining areas, used roads and culverts as travel corridors, and utilised a range of den substrates, including constructed habitat piles in areas where rehabilitation work had been carried out. Notably, we recorded the first evidence of chuditch raising young within areas under rehabilitation. With fieldwork now complete, the next phase will focus on analysing microclimate data, activity patterns across habitat types, and behavioural changes in females during the denning period.

# Internal projects

| PILLAR | PROJECT TITLE | Phase (2025) |
|---|---|---|
| First Nations Two-Way Science | Identifying and prioritising Aboriginal research needs | Commenced |
| | Noongar management of NJF: Indigenous biocultural knowledge – a literature review | Commenced |
| Enhancing Forest Flora Knowledge | Ecological impacts and recovery trajectories of fire in rehabilitated areas and forest ecosystems | Continuing |
| | Publication of the recalcitrant survival trial | Commenced |
| | Turner Block thinning trial | Continuing |
| Rehabilitation Execution | 2023 Willowdale direct return topsoil and seeding trial | Completed |
| | International principles and standards for the ecological restoration and recovery of mine sites | Commenced |
| | New Completion Criteria field trial | Commenced |
| | Quantifying contour rip line error | Completed |
| | Transplanting ancient grasstrees to rehabilitated areas | Commenced |
| | Evaluating the effectiveness of V-shaped tine ripping for reducing erosion | Commenced |
| | Optimising phosphorus management for jarrah forest rehabilitation | Commenced |
| | Unlocking germination potential for successful mine rehabilitation in the jarrah forest | Commenced |
| | Assessment of waterproofing methods for topsoil storage | Commenced |
| Water Stewardship | Assessment of the mining impacts on water quality using baseline and paired catchment (mined /unmined) monitoring with high-resolution sensor networks | Proposed |
| | Scope of work for surface water field studies - case study - (Drainage protection slot) | Proposed |
| Fauna Protection and Return | Post-mining habitat use by chuditch | Continuing |
| | Developing ethical traps for mygalomorph short-range endemic spiders | Continuing |
| | Re-burrowing capacity of mygalomorph spiders | Continuing |
| | Use of artificial nest hollows by Black Cockatoos in the Northern Jarrah Forest | Continuing |
| | Use of retained nest trees by Black Cockatoos | Continuing |
| | Quokka population mapping | Continuing |

# Collaborative projects

| PILLAR | PROJECT TITLE | Institution | Phase (2025) |
|---|---|---|---|
| First Nations Two-Way Science | Place-based and scale-based designation of culturally significant entities | Curtin University, GKB | Commenced |
| Enhancing Forest Flora Knowledge | Community completeness in monitoring of post-mining restoration success (ARC Linkage Project) | Murdoch University, The University of Western Australia, Iluka Resources Ltd, University of Tartu, Estonia, University of Camerino, Italy | Commenced |
| | Dark diversity in the context of species pools and functional pools: patterns, processes, and applications (PhD) | Murdoch University | Continuing |
| | Using remote sensing to monitor and assess rehabilitation | Wildlife Conservation Society | Commenced |
| Rehabilitation Execution | Assessing Alcoa's seed and plant sourcing strategy | Flinders University, DBCA | Commenced |
| | Australian Seed Scaling Initiative: Large-scale deployment of diverse, enhanced seed mixes using customised precision seeding technologies (CRC TiME) | CRC TiME, UWA | Continuing |
| | Ecophysiology of seed dormancy and germination of *Hibbertia* to inform seed propagation for ecological restoration (PhD) | UWA, CRC TiME, DBCA | Completed |
| | Evidence for effective climate-adapted seed sourcing strategies for revegetation success and transition to mine closure in a changing climate Phase 1 | CRC TiME, Murdoch University, DBCA, CSIRO | Completed |
| | Improving soil structure and water dynamics | To be confirmed | Proposed |
| | Predicting erosion through analysis of surface characteristics (PhD) | UWA | Continuing |
| | Seed bank dynamics of stockpiled topsoil | DBCA | Contracting |
| | Seed germination of native Ericaceae species required for mine site restoration | Curtin University, South32 | Commenced |
| | Soil health for mine rehabilitation, monitoring and assessment: a desktop study | The University of Reading and Federation University | Contracting |
| Water Stewardship | How do regolith and tree density influence canopy resilience of native and rehabilitated jarrah forest to heat and drought? | UWA | Commenced |
| | Long-term changes in catchment groundwater storage and associated streamflow, and application to forest management in a drying climate | Natural Resources Analysis | Commenced |
| Fauna Protection and Return | Bird assemblages in rehabilitated bauxite mine sites and surrounding forest in south-western Australia | Natural Resources Analysis | Continuing |
| | Investigating the conservation biology of trapdoor spiders *(Idiosoma)* in the Darling Range | DBCA | Continuing |
| | The use of road underpasses by feral cats (Felis catus) and native wildlife | Murdoch University | Completed |
| | Taxonomic revision and analysis of the role of sexual selection in driving speciation in *Aname* | UWA and WAM | Continuing |

# 2025 Environmental Research Symposium

In 2025, the Forest Research Centre delivered the third annual Alcoa Environmental Research Symposium. Supported by Murdoch University's Harry Butler Institute and held onsite at Murdoch, the full-day symposium brought together more than 130 people from across 30 key research, academic and government organisations.

The event featured 17 presentations, a panel discussion, and a one-on-one interview, providing key insights across fauna, flora, rehabilitaiotn practices, water, and approaches to Traditional Owner forest management knowledge and practices.








# Collaboration, outreach and communication

A key aspect for building recognition for the FRC through 2025 was engagement – both internally and externally – through a range of activities including, but not limited to, research papers, reports, higher degree by research theses, internal memos and work instructions, and both internal and external conference presentations. The FRC also contributed to public-facing communication pieces and multi-institutional projects to help strengthen Alcoa's reputation and support positive outcomes for the region.

| Deliverable Type | Reference |
|---|---|
| Published papers (Alcoa co-authored) | **Commander, L. E., Saavedra-Mella, F., & Lilly, A. (2025).** Rehabilitation of the Jarrah Forest in Western Australia. Australasian Plant Conservation: Journal of the Australian Network for Plant Conservation, 34(1), 8-11. |
| | Parkhurst, T., **Commander, L.**, & Standish, R. J. (2025). Global ecosystem accounting standard: A solution to monitor, mitigate, and transparently report global mining impacts in support of biodiversity goals. One Earth, 8(9). |
| Published conference proceedings (Alcoa co-authored) | **Saavedra-Mella, F., Mullins, G., Blackburn, C., Barker, J., & Commander, L. (2025).** Advancing Progressive Rehabilitation through Research and Innovation. Proceedings of Life of Mine: Mine Waste and Tailings Conference 2025, Brisbane. |
| Higher degree by research thesis | **Walters, C.** The use of road underpasses by feral cats and native wildlife (Masters, Murdoch University) – Published: 2025 |
| | **Henningsen, S.** - Ecophysiology of seed dormancy and germination of Hibbertia to inform ecological restoration (PhD, University of Western Australia) – Submitted: 2025 |

Following development of a dedicated FRC section of the Alcoa Australia website, many communication materials have been made available for public access, including several videos. The website can be accessed by scanning the following QR code with your device camera.

**Scan the QR code or visit**
**https://www.alcoa.com/australia/en/sustainability/forest-research-centre**

# 2026 forward-looking plan

In 2026, the FRC will build on the foundations established in 2025 to deliver a more integrated, business-aligned, and bio-regionally relevant research program. Our focus will shift from establishing capability to consolidating delivery, strengthening partnerships, and advancing long-term strategic research questions that support both Alcoa's operational needs and broader Northern Jarrah Forest (NJF) priorities.

The FRC aims to grow its portfolio of co-funded research via industry partnerships and competitive grants. This will expand research capacity, distribute costs, and elevate the centre's role as a key contributor to regional environmental knowledge.

Internal co-design for the 2026 Research Plan has commenced using an open contribution process across the business. Submitted ideas will be prioritised using the same robust criteria applied in 2025, with new tactical projects added based on alignment to business needs, feasibility, and expected impact.

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## Acknowledgement of contributions

We thank the many Alcoa colleagues who have supported our work throughout the year. We are especially grateful to the Social Performance, External Affairs, Plant Production, Rehabilitation Monitoring, Rehabilitation Performance, Global Planning, Legal, Finance, Procurement, Human Resources, and on-the-ground teams.

We recognise and appreciate everyone who has contributed to the research co-design process; draft and review scopes of work, research agreements, reports and articles; expanded our network; supported staff recruitment; and assisted with selecting field sites and installing field trials. Each of these efforts has helped strengthen and advance the Forest Research Centre's work and impact.

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