



STATEMENT OF CORPORATE INTENT 2013-18

SCIENCE AND ENVIRONMENT FOR A
BETTER NEW ZEALAND



Landcare Research
Manaaki Whenua



Landcare Research at a Glance

Our Core Purpose is to drive innovation in New Zealand's management of terrestrial biodiversity and land resources in order to protect and enhance the terrestrial environment and grow New Zealand's prosperity. Landcare Research was formed in 1992 and is one of the seven current Crown research institutes (CRIs). CRIs function as independent companies but are owned by and accountable to the New Zealand Government. Our shareholders are the Minister of Finance and the Minister of Science and Innovation, and we work as part of the Crown to deliver benefit to New Zealand.

We have 380 staff at nine locations across New Zealand, including our subsidiary carboNZero Holdings at Lincoln and Auckland. We collaborate extensively with other research organisations in New Zealand and around the world. Our science revenue (about \$55 million per year) is derived primarily from contracts with the Ministry of Business, Innovation and Employment (MBIE), Ministry for Primary Industries (MPI), Department of Conservation (DOC), Ministry for the Environment (MfE), Animal Health Board (AHB, now OSPRI), local government, private sector businesses and organisations, and Māori organisations.

The Government appoints our Board of Directors, and invests them with significant accountability for value to be derived from science and innovation funding – Landcare Research receives approximately \$24 million per year of government revenue in a Core Funding Agreement from MBIE. The shareholding Ministers expect the Board to take strategic advice both from leading scientists and key stakeholder partners through our Science Advisory Panel and Outcome Advisory Panel. The Board reports to shareholding Ministers in regard to Landcare Research's activities, impacts and achievements and progress towards the four National Outcomes of our Core Purpose.

Manaaki Whenua – Manaaki Tangata Care for the Land – Care for the People

Our Māori name means to care for the land in all senses. Māori are tangata whenua, the indigenous people with whom we consult and collaborate. Our recognition of and respect for Māori as tangata whenua is reflected in our Guiding Philosophy and the Voices for Sustainability pages of our public website.

www.landcareresearch.co.nz

Statement of Corporate Intent 2013-18

Landcare Research New Zealand Ltd
(Manaaki Whenua)

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Landcare Research's Niche

Our Vision

Science and environment for a better New Zealand.

Our Core Purpose

Landcare Research's Core Purpose is to drive innovation in New Zealand's management of terrestrial biodiversity and land resources in order to both protect and enhance the terrestrial environment and grow New Zealand's prosperity.

Stakeholder Partnerships

Landcare Research will fulfil its Core Purpose through the provision of research and transfer of technology and knowledge in partnership with key stakeholders – including business and industry, central and local government and Māori – to achieve our four National Outcomes.

Our National Outcomes

1. Improve the measurement, management and protection of New Zealand's terrestrial ecosystems and *biodiversity*, including those in the conservation estate
2. Achieve the sustainable use of *land resources* and their ecosystem services across catchments and sectors
3. Improve the measurement and mitigation of *greenhouse gases* from the terrestrial biosphere
4. Increase the ability of New Zealand industries and organisations to *develop within environmental limits* and meet market and community requirements

Our Scope of Operation

Landcare Research is recognised as the lead CRI in the following areas:

- Catchment-level ecosystems (including wetlands) and related ecosystem services
- Terrestrial vertebrate pest control
- Terrestrial carbon processes and inventory, and other greenhouse gases from soil and land
- Land cover, land use capability and effects, and spatial land information that integrates across sectors and scales
- Soil characterisation, processes and services
- Integrated social and biophysical research to support the sustainable management of terrestrial biodiversity and land resources.

Landcare Research is expected to work with other research providers and end-users to contribute to the following:

- Biosecurity, land, soil and freshwater management
- Climate change adaptation and mitigation
- Industry and business environmental performance including verification
- Indigenous forestry
- Urban environments
- Antarctica

Our Approach

We will:

- Focus on *growing the prosperity* of New Zealand across the dimensions of economy, society, culture and environment
- Be proactive in working with stakeholder partners to develop *evidence-based solutions to present and projected challenges*
- Use *collaborative research* and *integrative approaches* in creating solutions that bridge sectors, scientific disciplines, mātauranga Māori, and both landscape and temporal scales
- Address *complex environmental problems* and the associated often-polarised views of stakeholders with appropriate techniques, and be proactive in ensuring the *role of our science* evolves to meet the expectations and needs of society
- Achieve high standards of *science excellence* and *science capability*, which are supported by *careful stewardship* of and *strategic investment* in our knowledge assets, capability and key infrastructure, to benefit New Zealand
- Achieve *effective and timely technology and knowledge transfer* to meet the needs of end-users, community stakeholders and research collaborators
- Carry out our activities in accordance with the *CRI Operating Principles* (www.landcareresearch.co.nz/about/our-core-purpose)



The new Beever Plant Pathogen Facility, named in honour of Jessica and her late husband Ross, was opened by Jessica (right), with her son Graham and sister-in-law Susan Woods. (photo: Peter Buchanan)

Chair & Chief Executive's Overview

We are pleased to present Landcare Research's Statement of Corporate Intent (SCI) for the period 2013-2018. This provides a foundation for the agreement on our contribution to National Outcomes between the Crown research institute and our shareholding Ministers.

Environmental Performance with Integrity

Government's vision of improving the quality of natural resources while growing exports from 30% to 40% of GDP puts the work of Landcare Research (along with our collaborators in science, government and industry) at the forefront of strategy for natural resources. New Zealand needs a strong evidence base regarding environmental performance on which to base government policy and industry's priorities; and it needs solutions to environmental challenges.

Landcare Research is positioned and resourced to meet these needs. We see the value we add as enhancing environmental performance with integrity. This notion of integrity in environmental performance is increasingly part of both businesses' social licence to operate within New Zealand and brand strength for New Zealand exporters in overseas markets. It is also significant to government in developing policy that has meaningful impact on the future of our natural resources and the social well-being that they provide.

Business Growth Agenda

In this SCI we set out our strategies and plans for investing in valuable science that has impact for users and contributes towards National Outcomes. We signal a shift in that investment towards the themes of Government's business growth agenda – notably land and water issues, biodiversity offsetting, Māori economic development, the greening of growth, and improving the evidence base supporting regulatory and planning decisions (see next section).

Landcare Research is well placed to support primary industry, and local and central government to deliver on the business growth agenda because of the number and diversity of agencies and sectors that we serve, either directly or in collaboration with other research providers. This reflects the fact that our focus is on the terrestrial environment, which underpins all sectors through the services that it provides. We interact with sectors through collaboration with other CRIs and directly where we have distinctive contributions to make. We are distinctive in combining environmental, social, economic and cultural science skills; in working across scales from the catchment, to regional and national; and in working across timescales from the distant past and present to help anticipate the future.

National Assets

Landcare Research's science investments are also distinctive because we hold a number of New Zealand's Nationally Significant Databases and Collections (plants, invertebrates, fungi, microbes, soils, land information, vegetation plot survey information). This means that a third of our Core science funding from MBIE is dedicated to the curation and development of national science assets. A strong theme in our investment over the recent decade has been enhancing the accessibility and usability of information held in the collections and databases (see Delivery Horizons, page 19) to support national biodiversity and biosecurity priorities and protect New Zealand's primary industry, tourism and recreation sectors. This is a significant step towards doubling the value of science – a goal set by our shareholding Ministers. Such enhancements will continue through developments such as the National Land Resource Centre, the New Zealand Organisms Register, e-Biota and the new Antarctic Web portal under development.

Integration in the Science Ecosystem

Another strong theme in the coming five years is integration between research providers, government, industry, iwi and communities. Integration breaks down traditional silos in the science sector. Landcare Research has strongly promoted the *Productive Land Innovation Hub* (*'The Lincoln Hub'*, page 9) as a means for increasing the value of land-based exports while improving the quality of our natural resources. We similarly encourage the integration of mātauranga Māori in both scientific research and resource management frameworks (page 36).

We also anticipate greater collaboration across the whole science sector to result from the *National Science Challenges* (NSCs) and look forward to the selection of the challenges by Cabinet (occurring as this SCI goes to press). We will contribute strongly to facilitating the effective, close integration of science with government and industry as appropriate, Landcare Research is well placed to play a major role in its areas of core purpose: productive land, catchment management, biodiversity, biosecurity and growth within limits.

Financial Sustainability

In recent years, Landcare Research's financial position has been strong, with retirement of debt, increasing ROE, strategic investments being possible and dividends paid to Government. However, since the global financial crisis and government's greater cost-efficiencies, Landcare Research's revenue from major public sector clients has been static or declining. Core contract revenue accounts for over 40% of our annual revenue and this (like the long-term FRST/MSI contracts before it) has been fixed, while costs have been subject to inflation.

Our focus is on cost-efficiency: achieving more from less. Amongst the CRIs, we have one of the lower support-to-science cost ratios. By drawing on KiwiNet, Auckland UniServices and Callaghan Innovation we plan to enhance technology development while holding down our costs. We lease space in our offices to related stakeholder organisations (e.g. MPI, Aqualinc, Landcare Trust) to enhance value from our assets and strengthen relationships. And we implement secondments and staff-sharing arrangements (e.g. with DOC) where it helps to build and sustain national capability.

We are developing additional markets for our science, both in New Zealand and overseas, achieving benefit for New Zealand through technology services and investment. For example, we have engaged with global organisations to expand the reach of our carbonZero^{Cert™} programme while ensuring it is a successful stand-alone entity adding value to businesses in New Zealand. The carbonZero programme is a good expression of how we add value to clients – enhancing their environmental performance with integrity.

Response to our Operating Environment

Landcare Research contributes to the Government's work to enhance economic growth through initiatives in the areas of Natural Resources, Innovation, and Export Markets, and in cross-cutting themes on Māori Economic Development, Greening Growth and Resource Management Regulation. Some examples of significant initiatives by Government and/or Industry, in which Landcare Research will play a role, are provided below. These are examples of major developments in our operating environment to which we are adapting our capability and collaboration.

Natural Resources

Water reform

While New Zealand has an abundance of freshwater, some regions are reaching sustainable limits for water use. Growth in demand risks reducing the reliability or availability of water for existing users. Management of nutrients (nitrogen, phosphate) remains a particular challenge in New Zealand, especially where water quality has already declined.

What we are doing: Landcare Research contributes across the spectrum of water issues, recognising that what happens with and in freshwater usually starts on the land. The link between land use and water use and quality will be a major theme in the Productive Land Innovation Hub at Lincoln. Landcare Research will bring its experience in delivering participatory planning processes for community engagement (in order to understand and respond to multiple community and cultural values for local waterways), integrated economic and science models (e.g., New Zealand Forest and Agricultural Regional Model (NZ-FARM), page 20) to support sustainable land use and catchment management, and spatial information science used, for example, in precision irrigation control (pages 23) and Overseer® (pages 28, 32)

Land and resource use

The Government's Business Growth Agenda explicitly recognises both the role of innovation in growing the export economy and the importance of science in supporting the sustainable use of New Zealand's natural asset base. The policy framework recognises the contribution of the science system in working with resource managers, policy decision-makers and industry to improve the economic gains from land use while minimising the environmental impacts. Better management of New Zealand's land and water resources will enable long term sustainable growth while maintaining the quality of our natural resources.

What we are doing: Landcare Research is well placed to lend momentum to this area. We created the National Land Resource Centre to make information and technologies more readily accessible for land managers and policy makers, and to help coordinate research and technology efforts across organisations. Through the Centre we provide a range of information products and tools, such as the Māori Land Visualisation Tool, that help users enhance the value they can derive from the land.

Advancing biodiversity: Predator-free New Zealand

There is a growing national conversation on (and associated public awareness of) the possibility of achieving national predator free status by 2050 for pest species such as rats, mice, possums and stoats. Such an ambitious goal would require significant scientific and technical input as well as significant financial resources. It will build on New Zealand's international reputation for eradication of predators on off-shore and on-shore islands and significantly support the many community initiatives in this pursuit.

What we are doing: Landcare Research is already highly-regarded for its work on increasing the effectiveness of mammalian pest control with relevant agencies and the Sanctuaries of New Zealand network. Our science is well aligned to defining and addressing the multiple long-term challenges of achieving, maintaining and monitoring pest free status at local, regional and national scales. We are aligning our efforts with new and existing groups – the Predator-free New Zealand Trust, the Better Border Biosecurity collaboration and AHB-OSPRI (Operational Solutions for the Primary Sector).

Māori Economic Development

Māori approaches to asset management integrate economic development with the environment, people, history and culture. The Māori asset base is estimated to be worth around \$36.9 billion, \$10.6 billion of which is derived from the primary sector. The Crown recognises the significant potential to grow the value of the Māori economy and will soon respond to the 2012 report by the Māori Economic Development Panel. As significant resources are returned to Māori through the settlement of Treaty claims, iwi increasingly expect that science will help them realise opportunities for economic development.

What we are doing: Landcare Research is the only CRI involved in the Māori Land Productivity Initiative – Te Kōkirimo te Whāinga Hua o Ngā Whenua Māori – a collaboration between Māori organisations, large primary sector corporates and science. Our contribution will build on our earlier work partnering with Te Puni Kōkiri and others to develop the Māori Land Visualisation Tool, to optimise land use and ensure appropriate information and decision-making tools are available to Māori land owners. Landcare Research’s science follows a similar integrated approach to that of Māori; we endeavour to align scientific and traditional knowledge to help our Māori partners achieve their aspirations, especially post-Treaty of Waitangi settlements (page 36).

Green Growth

Green growth – the notion of economic growth within environmental limits – is gaining wider acceptance domestically and internationally. Consumers in New Zealand’s key trading markets are increasingly demanding products and services that have sound (and defensible) environmental credentials. Science has a key role in supporting New Zealand’s competitive position in global markets by providing a social licence to operate.

What we are doing: Landcare Research has considerable expertise in demonstrating the environmental credentials of New Zealand exports through our internationally recognised CEMARS[®], and carboNZero^{Cert™} certification and the Enviro-Mark[®] programme; and we see growth potential in this area. Increasingly, we are working with the Sustainable Business Council, BusinessNZ and New Zealand companies to provide evidence of good biodiversity, natural capital and ecosystem services management. Although a number of scientific and technical issues need to be resolved, Landcare Research is at the forefront of efforts to develop biodiversity offsetting practices with our key partners.

Resource Management

Evidence-based policy

Effective policy formulation requires good policy advice based on objective evidence. Increasingly, policy-makers are being asked to make decisions about complex policy issues that have a major scientific and or technological component, either in terms of origin or solution.

What we are doing: Much of Landcare Research’s science is tailored to provide central and local government decision-makers with a sound evidence-base. Our work on policy tools for enhancing water quality (e.g. NZO-FARM) are widely used – as are tools for carbon accounting, biodiversity measurement, sustainable land use, greenhouse gas mitigation, soils and resource economics. These tools support complex policy decision-making. We are working with key partners in New Zealand and overseas (where the same challenges are faced) to increase the relevance and accuracy of our science, the accessibility of our information and knowledge and the utility of linked economic-environmental models.

Science integrity, risk and uncertainty

There must be a high level of integrity in analysing and interpreting data, and they must be honestly represented and used. Stakeholders now require estimates of uncertainty and risk for quantitative assessments used to develop policy options. Recognising this need, the development of robust methodologies to assess uncertainty is becoming a major focus in our research.

What we are doing: We are investing Core funding in this area to better understand the drivers of uncertainty in scientific information and to quantify and reduce that uncertainty (page 42). This work recognises a pipeline from research design, through data acquisition, processing, communication and interpretation to final use of scientific

information in policy and management decisions. It will investigate the sources and impacts of uncertainty along that pipeline.

Callaghan Innovation

On 1 February 2013, the Callaghan Innovation institute was established by the Government to drive innovation in the high value manufacturing and services sector. The institute manages \$115 million a year in government support for business innovation, working across many diverse industries.

What we are doing: Given Landcare Research’s innovative research in fields such as remote sensing, informatics, soil mapping and precision irrigation, there are opportunities for collaboration with Callaghan Innovation once it is fully operational. We will be pursuing those opportunities.



Director John Luxton (left) discussing broom control with Quentin Paynter

Stakeholder Engagement in our Science Framework

Goal

Landcare Research's key stakeholders value highly their involvement in the direction and resourcing of our research, knowledge transfer from our work, and also the trusted advice and constructive engagement they receive from our people.

Our Stakeholders

The Government, through MBIE, is our most significant stakeholder in terms of providing Core Funding and in setting National Outcomes and impacts to be achieved through that investment. We have frequent meetings with MBIE.

Other important stakeholder partners in terms of commissioning and adopting research to achieve national benefit are DOC, MPI, MfE, AHB, Māori organisations and local and regional government. While we work with many businesses and industry sectors, strategic engagement is mostly through BusinessNZ, the Sustainable Business Council and sector bodies such as DairyNZ, FAR and IrrigationNZ. Our Core-funded science must also be strongly aligned to the needs of all these partners. Formal meetings with the Outcome Advisory Panel provide a streamlined conduit for them to influence our science direction, priorities and delivery. The 2012 MBIE external Stakeholder Survey found that 83% of respondents were satisfied with the way we set research priorities, and 97% had adopted knowledge or technology from Landcare Research in the past three years. As tangata whenua, Māori are important stakeholders – in addition to our contribution to Vision Mātauranga (page 36), we participate in regular meetings, hui and capability-building initiatives with collaborating iwi.

Productive Land Innovation Hub

'The Lincoln Hub'

Achieving Government's target of exports increasing from 30% to 40% of GDP will depend largely on research and education supporting a major lift in agricultural productivity within environmental limits. Landcare Research has worked with AgResearch, Plant & Food Research, Lincoln University and DairyNZ to develop a hub concept for collaborative research, education and industry development activity that is centred at Lincoln but connected nationally and internationally.

The Productive Land Innovation Hub will stimulate innovation and entrepreneurial endeavour and build capability within the land-based and supporting industries by combining the intellectual power of over 900 research and industry professionals working in the region. The Hub will facilitate collaboration and networking opportunities, provide work-ready graduates for the land-based sectors and transfer knowledge to raise the economic and environmental performance of the whole sector.

The vision is that the Hub will attract the most able minds internationally to study and undertake research at Lincoln. The ultimate goal is for shared developments in infrastructure, and collaborative research and teaching activity to result in the better management of New Zealand's land and water resources enabling long term sustainable growth while maintaining the integrity of our environment. Landcare Research will bring significant resources to the Hub, both from its Lincoln-based headquarters and the rest of its national network. We will contribute to centres of expertise that, for example:

- Put soils and land information and technologies in the hands of farmers to manage their nutrient regimes and nutrient losses, water use and energy wastage and impacts on water bodies
- Integrate land and water information into models that support policy development and community self-governance
- Enable the management of biosecurity risks by providing real-time information on hazardous organisms and control of the spread of weeds, pests and diseases
- Enable the effective restoration of indigenous biodiversity (e.g. wetlands) to meet farmers' and communities' expectations
- Certify activities to manage environmental impacts including carbon, water and energy footprints
- Integrate Māori traditional knowledge and scientific approaches to help meet community aspirations for growth within social and environmental tolerances
- Engage the community in collaborative governance of natural resources

Outcome Advisory Panel

This panel consists of senior representatives from key partner stakeholder organisations in central and local government, industry and business, the primary sector and iwi. The Panel meets with our Senior Science Managers twice yearly to provide high-level strategic advice to the Landcare Research Board, and to provide input into our Outcome investment strategies review process.

Steering Groups and Technical Advisory Groups

Steering Groups are formed when a product or service requires specific advice on development, uptake, maintenance or implementation. *Technical Advisory Groups* provide planning and operational guidance to particular projects.



National Land Resource Centre

The *National Land Resource Centre* (NLRC) is an excellent model of stakeholder engagement across agencies and sectors to develop science and technology of benefit to New Zealand. The NLRC will continue to strengthen collaboration across central government agencies, regional councils, CRIs and universities. At the same time, it will be engaging across the primary industry and government sectors to identify and address their capability and professional development needs. Through its website, the Centre provides easy access to a wide range of soils and land-focused resources (maps, data and tools) from a wide range of organisations.

Discussions across 16 agencies (Federated Farmers, regional councils, the Sustainable Business Council, CRIs and universities) around both the National Priority for Land and Water and the contribution that science could make to land productivity within environmental limits, resulted in a collective submission to the Government's National Science Challenges. The Centre was initially funded through strategic investment but is now supported through science operational budgets.

New Zealand Organisms Register

The *New Zealand Organisms Register* (NZOR) is a dynamic authoritative dataset of all the names accruing to New Zealand's terrestrial, freshwater and marine biodiversity. It is the most complete digital species catalogue of any country, and the NZOR infrastructure is unique. The response from stakeholders has been positive and significant applications are in the pipeline. Project partners intend that NZOR data and services will form an essential part of New Zealand's data access systems and be openly and freely available.

Landcare Research led the design and development of the NZOR system, managed the governance and advisory group inputs, hosts the data infrastructure and web services, and provides the expertise and international connections to enable project partners to see their ideas realised. Project partners are the key data users (MPI, EPA and DOC), MBIE as the funder of the Core science infrastructure, and the initial data providers (NIWA, Landcare Research and Te Papa Tongarewa). All partners continue to be part of the NZOR steering group. NZOR is now moving towards a new business model to support ongoing governance, maintenance and development of the core NZOR infrastructure plus fund potential expansion to new users and data providers.

Key Performance Indicators

- Percentage and number of relevant funding partners and other end-users that have a high level of confidence in Landcare Research's ability to set research priorities, and the effectiveness of the collaboration or partnership (*MBIE indicator with data provided from their external survey; the 2012 survey found 83% of respondents were satisfied with the way we set research priorities, and 84% said the relationship was effective*)
- Total value of subcontracts to industry, government and Māori organisations per annum (*MBIE indicator*)

Science Framework for National Outcomes

Goal

Landcare Research’s science framework is clear, effective and facilitates engagement with stakeholders who collaborate with us in achieving National Outcomes (page 2).

Achieving National Benefit

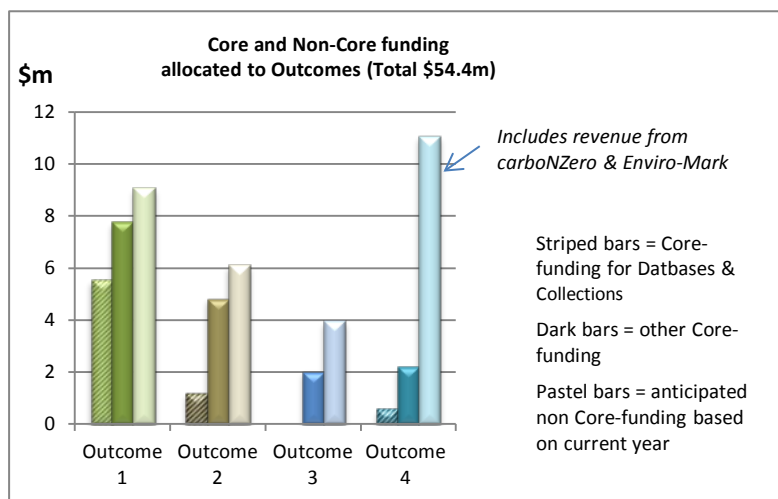
Our National Outcomes and Impacts, Outcome Investment Strategies and the science Portfolios that deliver on the Strategies, have all been developed with considerable input from our stakeholder partners and Advisory Panels.

Our National Outcomes represent the benefit to be derived from public investment in our science. With environmental science, some benefits are more readily quantified than others. For example, economic benefits from greater water-use efficiency in agricultural production can be more readily quantified than societal benefits from the conservation of iconic species or forests. Uptake of research findings into management and policy frameworks provides more immediate measures of our science influence. Our National Outcomes are described in detail in later sections (see pages 14-15)

Core Funding

Core funding represents approximately 80% of our total funding from MBIE and is subject to an annual performance agreement. Core funding is allocated to each of our National Outcomes.

The relatively large allocation to Outcome 1 reflects Landcare Research’s custodianship of several of the Nationally Significant Biological Collections and Databases (see Appendix 1). Landcare Research’s combined holdings are larger than for any other CRI, university or museum. The biological collections and associated databases are used to provide authoritative identification and assessments of invasive species risks to New Zealand natural and productive landscapes and so are vital to the delivery of Outcomes 1 and 4. The National Soils Database and New Zealand Land Resource Information System provide digital soils and land information to help inform land-use policy and resource management decision-making and so underpin Outcome 2. The annual amount of Core funding in Outcomes 1, 2 and 4 related to the Nationally Significant Databases and Collections are \$5.6m, \$1.2m and \$0.6m respectively.



Measuring Success

Key performance indicators measure our success in progressing Outcomes and Impacts on a 3-5 year timescale. The initiatives outlined for each of the Portfolios (pages 20-35) identify immediate research aims for the next year. These pages also identify key knowledge and technology transfer activities with stakeholders – these partnerships are focused on putting research findings into practice to maximise impact and benefit for New Zealand.

We report our progress against the Key Performance Indicators in our quarterly and Annual Reports, and on our public website. We similarly report research achievements and innovation as short highlights in these reports and in more detail as case studies available on our public website. (www.landcareresearch.co.nz/publications/innovation-stories)

Science Framework for National Outcomes

Goal

Landcare Research’s science framework is clear, effective and facilitates engagement with stakeholders who collaborate with us in achieving National Outcomes (page 2).

Achieving National Benefit

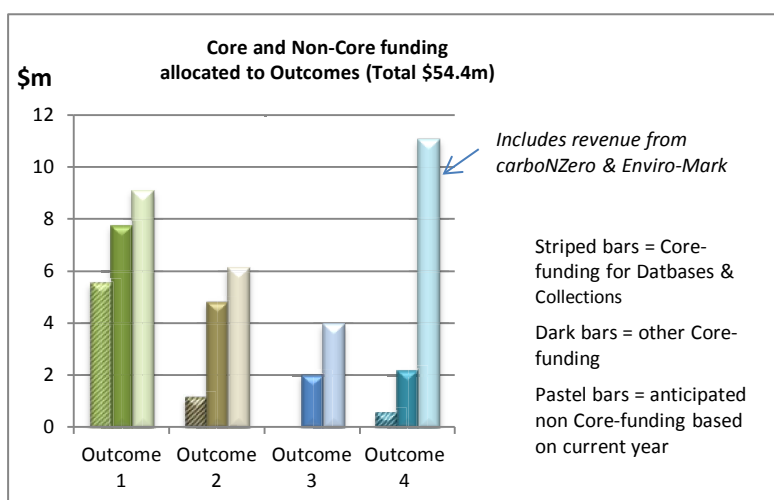
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Where applicable, we monitor the following to understand our sector impacts:

- The adoption of our tools, knowledge, technology and methodologies in operational management by end users, e.g. AHB, DOC, iwi, industry groups and sector groups and regional councils
- How contracted research findings and recommendations are used in policy development, regulation, planning and other decision-making by central and local government agencies, e.g. MPI, MfE, DOC and regional councils
- Use of online information from our databases and collections, and how this changes with new tools and increased accessibility of data



Kate Ladley (second from right) providing monitoring training to DOC Southland staff (photo: Em Oyston)

Shifts in Core-Funding Allocation between Outcomes

Shifts in allocation of core funding to each of the eight Impacts are based upon a set of criteria covering stakeholder relevance and engagement (including targeting new opportunities to support industry and stakeholder groups outside the public sector) and developing science innovation and capability in areas valued by key stakeholders. These adjustments then have a flow on effect to Portfolio allocations. The changes between 2013 and 2014 are:

- Moving \$570k of Defining Land Biota research associated with Nationally Significant Databases and Collections from *Biodiversity Trends* Impact 1.1 to *Integrated Environmental Solutions* Impact 4.2 to better meet the biosecurity needs of industry and government
- Re-aligning \$500k of biodiversity research from the *Biodiversity Management* Impact 1.2 to the *Integrated Environmental Solutions* Impact 4.2 to strengthen value to industry
- Re-aligning \$300k of Invasive Weeds, Pests & Diseases research from the *Biodiversity Management* Impact 1.2 to the *Integrated Environmental Solutions* Impact 4.2 to develop tools to support biosecurity in New Zealand
- Re-aligning \$846k of research currently in the *Greenhouse Gas Trends* Impact 3.1 to sit alongside carbon and nitrogen dynamics research in the *Sustaining Land Resources* Impact 2.2 to strengthen our research on soil services in dairy systems, including measuring greenhouse gas emissions.
- Decreasing research in *Greenhouse Gas Mitigation and Sinks* Impact 3.2 by \$84k to allow for greater support on erosion research under *Sustaining Land Resources* Impact 2.2

Science Priorities

Science priorities are set in consultation with our Outcome Advisory Panel and Board, key stakeholders in government, local government, industry and business sector groups, and iwi partners. An overall synthesis of issues raised by these stakeholders was presented to the Outcome Advisory Panel meeting in November 2012 to get their strategic input into revising our Outcome Investment Strategies. All Landcare Research staff and Portfolio Leaders were also invited to contribute. Changes were relatively minor but the four updated Investment Strategies better identify science priorities critical to the delivery of our eight Impacts and four National Outcomes.

Key Performance Indicators

- Percentage of relevant national and international research providers that have a high level of confidence in the Landcare Research's ability to form the best teams to deliver on its Outcomes (*MBIE indicator with data provided from their external survey; the 2012 survey found 91% of respondents were confident in this regard*)
- Percentage of relevant end-users who have adopted knowledge and / or technology from Landcare Research (*MBIE indicator with data provided from their external client survey; the 2012 survey found 97% of respondents have adopted our knowledge or technology in the past three years*)

Our National Outcomes & Impacts

National Outcome 1: Improve measurement, management and protection of New Zealand’s terrestrial biodiversity, including in the conservation estate

Key Performance Indicator: *The status and trend in national and regional biodiversity show an improvement in biodiversity in some environments, and a halt in the decline of representative examples of all others.*

Impact 1.1: Trends in national and regional biodiversity on public and private land are known and understood, based on best available definitions and descriptions for species and indices of ecological integrity.

Key Performance Indicator: *DOC and regional councils are using comparable metrics to measure status and trend and impacts of interventions on biodiversity within their jurisdictions*

2011/12 Baseline: A variety of methodologies were used to assess biodiversity so it was difficult to understand national and regional trends and to assess the impact of management interventions.

Impact 1.2: Frameworks are in place to ensure the most threatened ecosystems, habitats and species are managed to reduce the risk of decline in native biodiversity.

Key Performance Indicator 1: *Consents related to land-use change under the RMA are informed by a scientifically-based set of criteria that take account of cumulative effects on habitat availability*

2011/12 Baseline: Resource Management Act (RMA) processes were informed by a variety of evidence, with no nationally-consistent biodiversity framework or context

Key Performance Indicator 2: *Management decisions by DOC, MPI and regional councils, aimed at reducing threats to species and habitats, are based on robust risk models that reflect best available knowledge about the efficacy, cost and acceptability of management strategies and tools.*

2011/12 Baseline: Management decisions largely *ad hoc* with inconsistent application of robust biodiversity value and risk modelling.

National Outcome 2: Achieve the sustainable use of land resources and their ecosystem services across catchments and sectors.

Key Performance Indicator: *New Zealand land use is matched within the land resource’s environmental limits and key ecosystem services are maintained or enhanced.*

Impact 2.1

The status and trends of land resources and ecosystem services (including their interactions) are known and understood.

Key Performance Indicator: *LCDB (land cover), LUDB (land use), S-map (soil) and ESDB (ecosystem services) components of LRIS (Land Resource Information System) have been enriched and are being used under the New Zealand Government Open Access Licensing framework for web-services*

2011/12 Baseline: Earlier versions of the land resource databases contained out-of-date information, with incomplete coverage for end user needs, and with some barriers to open access

Impact 2.2

Opportunities and threats to land resources and ecosystem services are recognised and balanced to maintain or enhance the provision of ecosystem services.

Key Performance Indicator: *Regional councils and the irrigation, pastoral and arable sectors are using knowledge of soil variability to improve the match between land use practices and land capability*

2011/12 Baseline: ‘Ecosystem services’ modelling and decision-making were not widely applied by regional councils, and soil variability was generally only recognised at the landscape scale

National Outcome 3: Improved measurement and mitigation of greenhouse gases from the terrestrial biosphere.

Key Performance Indicator: *New Zealand is meeting its international reporting obligations and reducing net greenhouse gas emissions from the terrestrial biosphere.*

Impact 3.1

The status of terrestrial greenhouse gas emissions and removals are known, and changes in relation to management strategies, land use policies and global change are forecasted.

Key Performance Indicator: *MPI and MfE are using verified estimates of greenhouse gas emissions and carbon storage to reduce uncertainty in national inventories*

2011/12 Baseline: Estimates of greenhouse gas emissions, and how these changes with altered land use, contained many uncertainties

Impact 3.2

Land use options, asset management and other methods that increase carbon storage and mitigate greenhouse gas emissions are understood and balanced for environmental, economic and social benefits

Key Performance Indicator: *Validated methodologies and land use practices to mitigate greenhouse gas emissions and increase carbon storage and adapt to likely climate change effects*

2011/12 Baseline: Models of carbon dynamics were largely inadequate for understanding wider implications of land use

National Outcome 4: Increase the ability of New Zealand industries and organisations to develop within environmental limits and meet market and community requirements.

Key Performance Indicator: *Integrated solutions add value in industry, international markets; meet and demonstrate compliance with regulatory and market requirements; reduce costs of production; and provide measurable benefits to local communities*

Impact 4.1

Factors (including the form of institutions) required to resolve complex environmental issues adapt to global change and reduce vulnerability to resource scarcity are understood and recognised.

Key Performance Indicator: *Industry sectors, central and local government are making strategic use of research findings, associated indicators of performance, and new economic instruments to respond to complex environmental issues, global change processes and resource scarcity.*

2011/12 Baseline: Diverse stakeholders were in a variety of conflicts over the management of natural resources (e.g. water, biodiversity) with differing values and expectations

Impact 4.2

Best solutions that integrate economic, social, cultural and environmental initiatives maintain or enhance international competitiveness, market access and social license for business and industry to operate.

Key Performance Indicator: *An industry sector (dairy, horticulture or energy) is using a framework for integrating economic, environmental, social and/or cultural drivers to meet community and/or market requirements*

2011/12 Baseline: Industries were beginning to use more sophisticated frameworks such as environmental footprinting (e.g. carbon and water) to support reputation and brand.

Key Performance Indicator (project-based to meet AHB's priorities): *Bovine TB is eradicated by AHB from vector populations in the two extensive and difficult forest areas*

2011/12 Baseline: TB persisted in parts of New Zealand, including a few significant areas where possums and deer are the main wildlife hosts

Alignment of Impacts to Key Stakeholder Priorities

Impacts	MPI	DOC	MFE
1.1 Biodiversity trends	New Zealand can better identify and manage potential biosecurity risks.	Definitions, status and trends data for key species, habitats and ecosystem services which meet New Zealand's national and international reporting commitments (CBD, IPBES)	Improved data and analysis to support State of the Environment reporting.
1.2 Biodiversity management	Reduction of harm to the natural environment from pests and diseases. Science contributes to more sustainable use of New Zealand's biological resources.	Improved tools and practices to manage threatened species and ecosystems	Stronger evidence base to support environmental policy setting.
2.1 Land resource trends	Improved definition of sustainable land use and impacts on ecosystem services at farm, catchment and sector scales.	More robust science-based monitoring of the state and trend of New Zealand's land resources.	Strengthened evidence base to support processes and targets for land and water monitoring.
2.2 Sustaining land resources	Improved policies, based on sound science, to protect ecosystem services and resilience based on sound science.	Greater definition of environmental limits leading to enhanced ecosystem resilience and maintenance of ecosystem services.	More effective management frameworks to improve the quality and availability of fresh water.
3.1 Terrestrial greenhouse gas trends	Improved measurement of greenhouse gas sources and sinks.	Climate change impacts on key ecosystems and species (including pest responses) are better understood and inform management decisions.	New Zealand's reporting commitments (Kyoto) are met.
3.2 Terrestrial greenhouse gas mitigation	Reliable and economic greenhouse gas mitigation technologies.	Greater definition of the ways in which conservation land benefits from and contributes to carbon accounting.	New Zealand's greenhouse gas emissions are reduced to below 'business as usual' in a cost effective way.
4.1 Trends in complex environmental challenges	Science supports farmers, forestry and pest managers to adapt to a changing climate.	Linkages between biodiversity, ecosystems and prosperity are better understood and factored into decision-making. Community, Māori and business expectations are understood and factored into management decisions.	New Zealand's negotiations in climate change action are science-based. Decision-makers have a more robust understanding of environmental limits and how they can be applied.
4.2 Integrated environmental solutions	Prevention and reduction of harm to economic and cultural resources from pests and diseases. The primary sectors use natural resources in an increasingly sustainable manner.	The adaptive management needs ahead of climate change are better defined. New Zealand has access to alternative economic instruments.	Frameworks are available to manage environmental effects and allocate resources within environmental limits. New Zealand is well positioned to respond to the global green growth agenda.

Impacts	Industry	Local government	Māori
1.1 Biodiversity trends	Tools are available for identifying and measuring biodiversity status and trends on private land.	Comprehensive biodiversity monitoring supported by sound science.	Mātauranga Māori and science to support kaitiakitanga and management of terrestrial ecosystems.
1.2 Biodiversity management	Science-based business tools for biodiversity and ecosystem management are available to and used by the private sector.	Biodiversity value in both productive and ecosystem-service landscapes.	
2.1 Land resource trends	Better understanding of the value of land resources and the opportunities arising from matching land use to land capability.	Determine the full range of ecosystem services and underpinning processes to achieve sustainable use of land.	Tools and services to manage Māori land assets within cultural aspirations; opportunities for sustainable development.
2.2 Sustaining land resources	Improved industry tools to increase resource-use efficiency (e.g. irrigation) and reduce environmental footprint.	Develop specific measures sensitive to change in ecosystem services and understand the risks, costs and benefits.	
3.1 Terrestrial greenhouse gas trends	A strengthened business case for industry to measure and mitigate greenhouse gases.	Determine state and trend of regional and New Zealand's net emissions.	Business opportunities to mitigate greenhouse gas emissions and create carbon sinks.
3.2 Terrestrial greenhouse gas mitigation	New, practical means of greenhouse gas mitigation are underpinned by science and supported by a credible certification regime.	Reliable and economic greenhouse gas mitigation technologies.	
4.1 Trends in complex environmental challenges	Improved definition and understanding of environmental limits and how they apply in the business context.	Increased production with decreased environmental footprints.	Mātauranga Māori and science integrated to balance environmental, cultural, economic and social aspirations, and achieve competitive advantage in the global market.
4.2 Integrated environmental solutions	Environmental performance is more integrated with core business management and strategy. Science plays a key role in eradicating TB from wild animal vector populations; and in managing plant, invertebrate and fungal biosecurity threats.	Improved management tools that incorporate community, regulatory, cultural and market needs.	

Research Portfolios

Science initiatives are clustered into ten Portfolios of complementary research, which work towards delivering our Impacts and National Outcomes. Individual science initiatives may contribute to different Outcomes simultaneously, e.g., work on ecosystem services may contribute to all Outcomes.

Our ten Research Portfolios are:

- Enhancing Policy Development
- Supporting Trade
- Realising Land’s Potential
- Managing Biodiversity
- Managing Invasive Weeds, Pests & Diseases
- Understanding Ecosystem Services & Limits
- Measuring Biodiversity Change
- Measuring Greenhouse Gases & Carbon Storage
- Characterising Land Resources
- Defining Land Biota

Aligning Portfolios to Outcomes

Stars indicate the Outcomes that each Portfolio contributes to; solid star signifies major contribution.

	Outcome 1: Biodiversity	Outcome 2: Land Resources	Outcome 3: Greenhouse Gases	Outcome 4: Growth within Limits	
Enhancing policy effectiveness (page 20)	★	★	★	★	Integrated Solutions
Supporting trade (page 21)	★	★	★	★	
Realising land’s potential (page 23)	★	★		★	
Managing biodiversity (page 25)	★			★	
Managing invasive weeds, pests & diseases (page 26)	★			★	Threats & Resilience
Understanding ecosystem services & limits (page 28)		★	★	★	
Measuring biodiversity change (page 29)	★			★	State & Trend
Measuring greenhouse gases & carbon storage (page 30)			★	★	
Characterising land resources (page 32)	★	★	★	★	
Defining land Biota (page 34)	★	★	★	★	

Delivery Horizons

All Portfolios contain a mix of technology and knowledge transfer activities (immediate year and usually ongoing), and applied and strategic research (2–7 years) that contribute to Impacts (3-5 years) and longer-term National Outcomes (10-15 years). Outcome 4 has a high component of product and service delivery (environmental certifications from the carboNZero^{Cert™} programme and Enviro-Mark[®]).

For example, research relating to our databases and collections spans multiple delivery horizons by:

- Providing regular identification services (day-to-day knowledge transfer to industry (e.g., agriculture, horticulture, viticulture, forestry, pharmaceutical, health), central and local government agencies, and other research and education providers
- Developing on-line tools and other services to make information more accessible for end users as above (day-to-day to short-term delivery),
- Supporting end-users with applied research such as carbon sequestration rates, vegetation succession trends, precision agriculture, plant pathology, weeds and animal pests (short-term to medium-term delivery), and
- Underpinning long-term strategic research across all Outcomes.

These collections and databases are deemed Nationally-Significant because they have a fundamental role underpinning all natural resource, biosecurity and biodiversity management and monitoring activities; as such they will deliver value and benefit to New Zealand in perpetuity.

Partnerships

Portfolios are funded by contributions from several sources, including our Core Funding Agreement with MBIE and strategic internal investments. Our most significant stakeholder partners in terms of research revenue are MPI, DOC, MfE, AHB, and local and regional government. Our work with many businesses and industry sectors is growing and strategic engagement is mostly through BusinessNZ, MBIE, DairyNZ, FAR and Future Forests.



Phil Lyver doing penguin research in Antarctica

Enhancing Policy Development

Effective policy is an important component of national and regional resource management and significantly influences the quality of decision-making within public and industry sectors and in organisations. However, the increasing complexity and interrelatedness of natural resource issues means new approaches are needed to engage stakeholders, analyse issues such as global climate change impacts on trade (strategic investment project, page 39) and adaptively manage or resolve issues.

This portfolio includes research that spans urban, rural and conservation landscapes, the full range of ecosystem services and their value, natural resources, and a wide array of stakeholders – central and local government, industry, NGOs, community and Māori organisations. The breadth of the work undertaken within the Portfolio contributes to all Outcomes and particularly to the Impacts relating to improved decision-making and policy and planning development. An example of this is the New Zealand Forest and Agricultural Regional Model (NZ-FARM) that we developed, initially for use in the Hurunui and Manawatu catchments but which has much wider application.

NZ-FARM optimises the balance between potential rural income and the environmental impacts of land use and changes in land management (pastoral, arable, horticultural, forestry, scrub or conservation). It provides decision-makers with information on the economic impacts of environmental policy and resource constraints and shows how policy that targets one issue could affect other environmental and economic issues. This is an important step forward in implementing the Land & Water Forum recommendations. NZ-FARM takes into account greenhouse gas emissions from agriculture and forestry, forest carbon sequestration, water use and water constraints, and nutrient (nitrogen and phosphorus) losses.

Areas of particular interest to Māori organisations include our work with a number of iwi and city councils on incorporating Māori values in policy, planning and reporting; and the use of Māori values in environmental management and monitoring frameworks to support freshwater limit setting processes.

Key Research Initiatives 2013/14

- Refine tools and approaches that will enable regional councils and central government to incorporate ecosystem services into their planning processes and operational decisions (Impact 4.1) *Continuing initiative*
- Identify a process and relevant indicators for regional councils to track the impact of their policies and resource management decisions, for example in relation to managing freshwater (Impact 4.1) *New initiative building on previous work in this and other Portfolios*

Key Knowledge and Technology Transfer Activities

- Provide industry and government with robust economic and social analysis for land management and policy decisions
- Deliver a series of 'Landcare Link' seminars for policy makers in Wellington to highlight where and how specific pieces of research can inform policy and decision-making
- Compile a series of Policy Notes for government, local government and industry covering specific advice, findings and evidence-based recommendations for natural resource management
- Work with regional councils and DOC to support the incorporation of ecosystem services into their decision-making processes

Research Collaboration

Key research collaborators include Aqualinc and NIWA (Land & Water Forum and support for water policy development, framework for interoperable freshwater models); the World Resources Institute (policy instruments to address multiple ecosystems services); the Cawthron Institute, NIWA and Lincoln University (water governance), NIWA, AgResearch, Bodeker Scientific, Motu Economic Research, Plant & Food Research, Waikato University, Victoria University of Wellington (climate impacts and implications).

Supporting Trade

The aim of this Portfolio is to increase economic prosperity while improving environmental well-being. The research enables business, and primary industries to meet community and market expectations for evidence-based sustainable practices. We develop the 'green growth' value propositions for New Zealand industry and sectors, and also the systems and frameworks to facilitate adoption of research into mainstream business. 'Green growth' credentials are increasingly seen as critical to market access and the New Zealand brand.

Research priorities include reducing the incidence of bovine TB, which is an economic and trade compliance issue for New Zealand's dairy, cattle and deer industries (this work also benefits biodiversity). The number of TB-infected cattle and deer herds in New Zealand has dropped dramatically from over 1700 in 1994 to just 58 in March 2012. This reflects local elimination of TB from possums as a result of sustained and intensive regional-scale possum control underpinned by our research. In collaboration with the Animal Health Board (AHB) and others, we have developed a conceptually new and highly quantitative framework for objectively assessing the probability that TB has been eradicated from specific areas. This will enable more sophisticated targeting of future control work, and is a crucial first step toward AHB's goal of eradicating TB from 2.5 million hectares over the next decade or so. Achieving local and regional eradication of TB will eventually reduce the annual cost of TB management (currently \$84m p.a.) and ensure that there is no likelihood of any resurgence in the threat that TB once posed to current market access for these industries.

We investigate potential opportunities for biological control of weeds, and the opening of our Beever Plant Pathology Facility (strategic investment) will significantly broaden the scope of such work and enable ground-breaking new research into interactions between plant pathogens and their hosts.

We develop value propositions for weed biocontrol and have developed a framework for prioritising target weeds and predicting the potential cost and feasibility of biocontrol.

We also prepare value propositions for biodiversity offset schemes, which aim to achieve positive environmental outcomes from land development projects, and the key indicators to measure this. Similarly, this portfolio assesses impacts of policy on sector performance, market developments in respect of sustainability and green growth, and provides support to businesses implementing environmental management and reporting systems.

Key Research Initiatives 2013/14

- Review approaches to natural capital accounting and design a methodology for biodiversity footprinting, which will be a future growth issue for policy and trade in the primary sector (Impact 4.2) *New initiative developing previous work in this Portfolio and the Managing Biodiversity Portfolio*
- Develop strategies (such as water footprinting) to ensure business and industry understand the implications of their activities on natural resources, so that ecosystem services considerations can be incorporated into business decisions (Impact 4.2) *Progressing an existing initiative*
- Develop cost-effective rabbit control through whole-of-farm optimisation systems to reduce toxin use (with lower costs) and to increase farm productivity and market access (Impact 4.2) *Continuing initiative*
- Develop a value proposition for environmental compensation that would increase the willingness of industry to fund pest control through environmental compensation (Impact 4.2) *New initiative, building on previous research*
- Develop strategies and tools for reducing the costs of TB surveillance and eradicating the disease from >5% of remaining areas per year; and determine and value the ancillary benefits derived from TB possum control (Impact 4.2) *Building on previous work in this Portfolio and the Managing Weeds, Pests and Diseases Portfolio*

Key Knowledge and Technology Transfer Activities

- Partner with the Sustainable Business Council roadshow, which will cover all main centres, to introduce the wider business community and industry sectors to a new framework for monitoring and managing impacts of their activities on ecosystem services, and thereby recognise opportunities to build reputation and improve company performance
- Work alongside the dairy, beef, and deer industries to facilitate adoption of improved knowledge, tools and strategies for TB management, including more cost-effective local eradication or suppression of TB
- Participate in the NZ Biosecurity Institute National Education Training Seminar (NETS) conference and Biosecurity Bonanza Workshop to present latest research and best practice guidelines to practitioners from DOC, AHB, MPI, regional councils and private contractors
- Work with the National Pest Control Agencies and MPI toolbox committees to update best practice guidelines

Research Collaboration

This Portfolio partners with Agribusiness and Economics Research Unit at Lincoln University (global trade developments, environmental footprinting and economics). Other key research partners include the AHB and University of Otago (sustaining TB freedom); and Massey University (the Life Cycle Management Centre).



Carlos Rouco Zufiaurre downloading proximity data from a possum collar (photo: Caroline Thomson)

Realising Land's Potential

New Zealand's long-term prosperity depends on balancing increased primary production against critical environmental limits and meeting the needs of all sectors in local communities. Research in this Portfolio will enable the primary sector, industry and policy managers to optimise both economic and environmental outcomes by better aligning land use with its natural potential, and minimise adverse impacts on land and water. By integrating land, water, biota, social, cultural and economic factors across catchments and sectors, we can better support sustainable production within environmental limits for Outcomes 2 and 4. The research also assists regional councils who are charged with managing the cumulative effects of land use on water quality and meeting water quality limits.

We provide – either directly or with/through other providers – the scientific evidence base, practical tools, techniques and technologies for developing and implementing new national freshwater policies and frameworks in response to the recommendations of the Land & Water Forum. Our work on measuring soil variability and real-time soil moisture at the paddock scale underpins the proven cost-effectiveness of precision irrigation.

Current, widely-used approaches for measuring leachate (and the contaminants in the leachate) under grazed pasture can be improved, especially at the farm-scale. We are working on techniques and technologies to enable the acquisition of robust data critical to evaluating mechanisms for ensuring farmer compliance with nutrient discharge limits.

Research of interest to Māori includes indigenous forestry with Tūhoe Tuawhenua Trust and Waitutu Incorporation, and catchment management/water quality with Te Uri o Hau in the Kaipara Harbour and with Rangitane in the Manawatū.

Key Research Initiatives 2013/14

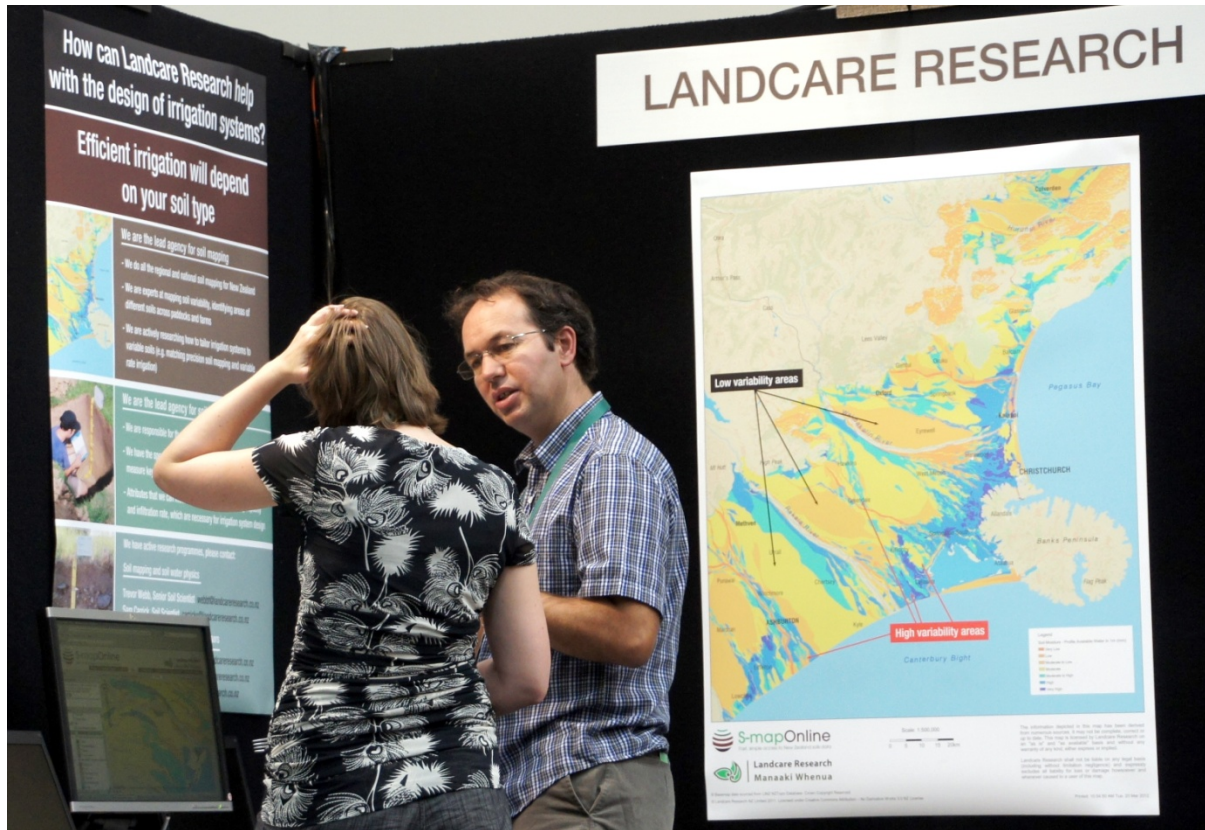
- Assess effects of land intensification (and technologies such as precision irrigation) on water quality and yield, and incorporate in catchment water inventory analyses (Impact 2.2) *New initiative building on previous research*
- Develop and refine approaches for scaling multiple ecosystem services to landscapes to enable resource managers to understand the full impact of land use activities and trade-offs on effects on ecosystem services (Impact 2.2) *Building on previous research in the Understanding Ecosystem Services Portfolio*
- Drawing on our expertise in ecotoxicology and soil processes, continue developing new approaches and understanding, for managing and mitigating land-based environmental contaminants (e.g. cadmium associated with use of phosphate fertilisers) (Impact 4.2) *Continuing research*
- Further explore the concept and application of landscape multi-functionality in the New Zealand context (Impact 2.2) *Continuing initiative*
- Develop an improved erosion hazard assessment approach to replace the 'potential for erosion' layer in NZLRI (Impact 2.2) *New initiative building on previous research*

Key Knowledge and Technology Transfer Activities

- Work with the irrigation, fertiliser and precision agriculture industries and local government to build on our knowledge of soil properties and soil variability, and develop technologies (e.g., lysimeters, wireless sensor networks) to improve water and energy-use efficiency and reduce environmental contamination.
- Provide advisory services to regional councils in regard to developing good policy and practice for managing contaminants to enable safe, productive use of land resources.
- Develop improved erosion modelling tools for regional councils and the primary production sector so they can improve management of erosion-prone hill country and reduce sediment loads entering rivers
- Continue working with the fertiliser industry to improve the effectiveness of nitrogen fertilisers and pasture nutrient management approaches in the context of New Zealand soils and climate

Research Collaboration

Key research partners include AgResearch, ESR and NIWA (clean water, productive land); ESR (biowastes); Scion (non-timber values of forests); AgResearch and Plant & Food Research (our partners in the Sustainable Land Use Initiative, SLURI); University of Waikato (soil dynamics) and the Pastoral Greenhouse Gas Research Consortium (nitrification inhibitors)



Sam Carrick discussing precision irrigation at a conference (photo: Adrienne Farr)

Managing Biodiversity

This portfolio works with central and local government's regulatory, management and policy agencies, iwi and community groups to sustain indigenous biodiversity where it is most threatened. Improved knowledge and tools for managing and protecting New Zealand's terrestrial and wetland biodiversity are needed to underpin a reversal in the current decline in biodiversity. Science will play a key role in maintaining and restoring threatened species, natural habitats and ecosystems to a healthy functioning state.

In collaboration with a range of end-users, we focus on understanding and predicting biodiversity outcomes from different types of management. This incorporates the identification, evaluation and mitigation of risks to vulnerable species and ecosystems, and restoration of ecological integrity. We are also working with a number of iwi to protect biodiversity of importance to Māori; and with Tūhoe as they develop governance models for their land.

Our new research will assist in the maintenance of biodiversity in productive landscapes. This will underpin 'green growth' marketing opportunities and help the primary sector and meet community expectations for environmental responsibility.

Key Research Initiatives 2013/14

- Enable DOC and regional councils to evaluate and prioritise sites that support naturally rare ecosystems through improved techniques for systematic conservation planning based on explicit measures of biodiversity (Impact 1.2) *Continuing initiative progressing from last year*
- Advance ecosystem-based approaches to determining the value and persistence of and threats to indigenous biodiversity with new models and assessment methods that allow the effects of land use decisions to be assessed by territorial authorities and regional councils (Impact 1.2) *New initiative building on previous work*
- Develop models of relationships between species and wetland communities and hydrological and nutrient regimes from both intact and modified wetlands that can be used to prioritise wetlands for protection, management and restoration (Impact 1.2) *Initiative continuing from last year*
- Facilitate improved biodiversity outcomes and stronger sustainability credentials through the establishment of a new partnership with New Zealand agribusinesses (Impact 4.2) *New Initiative being developed with reallocation of Core funding from Impact 1.2 to Impact 4.2*
- Develop case studies of how Māori employ kaitiakitanga strategies to manage and use biodiversity in order to improve cultural and environmental monitoring and management by government agencies (Impact 4.2). *Continuing from previous year*

Key Knowledge and Technology Transfer Activities

- Provide planning-relevant guidance to regional and district councils on appropriate methods and standards for assessing and monitoring changes in dryland flora and fauna
- Provide recommendations to Christchurch City Council for prioritising, protecting and managing rock outcrop communities (naturally rare ecosystems) of Banks Peninsula and the Port Hills, and for incorporating these into their Significant Natural Area assessments for the Christchurch City Plan.
- Provide guidelines to community groups for assessing biodiversity outcomes from near-zero pest levels to support private and local-body initiatives to enhance indigenous biodiversity.
- Provide guidelines to DOC/MfE on nutrient thresholds for the main wetland types in order to scope national limit setting in wetlands in support of the proposed national water reforms.

Research Collaboration

Key research partners include the Department of Conservation and several New Zealand and overseas research agencies

Managing Invasive Weeds, Pests & Diseases

Invasive species (weeds, pests and diseases) are the major threat to native biota in New Zealand, and one of the top five drivers of global change. This portfolio provides the underpinning knowledge of where, when and how to manage the impacts of weeds, pests and diseases, and to prioritise which species to control and/or eradicate in order to reverse the continuing decline of native species and enhance New Zealand's prosperity.

Complex interactions occur between various pests occupying the same landscape so the consequences of single species control have not always been as anticipated. Our research covers multi-species impacts, quantification of the benefits of extensive pest control for native invertebrates as well as birds, and landscape-scale approaches to invasive species management. Research is now extending beyond the protection of individual sites to the benefits of creating interconnected networks of conservation areas. This is highly relevant to DOC, regional councils and community groups managing mainland biodiversity sanctuaries. Even though possums are the main wildlife vector of TB (see page 21), AHB now routinely target both rats and possums with aerial control operations. Aspirations for a 'Predator-free New Zealand' by 2050 would require a quantum-shift in all such paradigms.

We are a Core Participant in the Invasive Animals Cooperative Research Centre (CRC), an AU\$19.7M programme of research and extension activities spanning all aspects of the management of terrestrial and freshwater vertebrate pest species. CRC participation is enhancing our research capability in three key areas – ecological modelling, biological control, and pest management – and targets invasive species of concern to both New Zealand and Australia. Benefits will accrue primarily towards addressing Outcome 1 (managing threats to biodiversity) and Outcome 4 (maintaining market access).

Of interest to Māori is our work with Tūhoe to develop strategies for managing possums for biodiversity goals while at the same time providing economic livelihood from fur and skin trapping; and our work with Kaupapa Kererū, a Ngāi Tahu-led conservation initiative on Banks Peninsula, providing research advice as needed. We also actively develop Māori capacity through postgraduate student supervision.

Key Research Initiatives 2013/14

- Quantify the economic benefits of implementing weed biocontrol programmes for at least two terrestrial weed species in order to demonstrate the value of biocontrol to the production sector (Federated Farmers, MPI, Beef & Lamb, DairyNZ) (Impact 4.2) *New initiative building on previous research, and reflects the reallocation of Core-funding from Impact 1.2 to Impact 4.2*
- Complete tests to confirm the suitability of biocontrol agents for at least two aquatic weed species, and demonstrate the potential benefits of biocontrol to regional councils and energy companies (Genesis Energy and Meridian) to encourage them to invest in biocontrol as an alternative to chemical and mechanical control of aquatic weeds (Impact 4.2) *New initiative building on previous research, and reflects the reallocation of Core-funding from Impact 1.2 to Impact 4.2*
- Characterise and quantify the responses of native biota to large-scale suppression of key pests (possums, rodents, feral cats and mustelids) in production landscapes to inform development of environmental credentials that could be used by the production sector (Federated Farmers, Beef & Lamb, DairyNZ, wine industry) to demonstrate the 'green credibility' of their exported products and to enable non-market valuation of the biodiversity benefits of pest control (Impacts 4.2 & 1.2) *New initiative building on previous research*
- Increase public acceptance and support for 'Predator-free New Zealand' by using bio-economic and/or social research methods to clarify the potential biodiversity, social and economic benefits accruing from large-scale pest control, and determine potential impediments to progressing pest control at scales relevant to 'Predator-free NZ' (Impacts 4.2 & 1.2) *New initiative building on previous and current research*

Key Knowledge and Technology Transfer Activities

- Demonstrate the economic value of weed biocontrol programmes to at least two government agencies and two industry groups to help them plan and budget for weed control activities, and justify such expenditure to their stakeholders.
- Demonstrate the non-market (e.g. biodiversity and social) benefits of large-scale pest control to at least four government agencies to help strengthen their partnerships with industry and business.
- Provide up-to-date forecasts (early warning) of potential pest irruptions to one national and one international agency to help them plan and budget for pest control activities.

Research Collaboration

Key research partners include the Australian-funded Invasive Animals Cooperative Research Centre (pest animals); AgResearch (weeds, including prioritisation, population modelling, herbicide use and optimising biodiversity benefits from weed management); Lincoln University (invasive mammal impacts); and the University of Auckland (invasive mammal impacts, and the Joint Graduate School for Biodiversity and Biosecurity).



Introduced heather beetles devouring heather in the central North Island

Understanding Ecosystem Services & Limits

'Ecosystem services' refers to the many benefits that society derives from ecosystems, i.e. maintenance of fertile soils, purification of water, and carbon storage. Many of these services are taken for granted until they are severely affected, which often requires expensive measures to restore the services (for example, river and lake clean ups). This Portfolio provides the evidence needed by policy-makers and resource managers to optimise multiple ecosystem services while making the trade-offs inherent in managing land resources.

The Portfolio will better determine the causes and consequences of ecosystem change. There is a growing need for this given increases in two major landscape transformations in New Zealand: land use intensification and weed invasions in marginal lands. Understanding how to mitigate the negative consequences of these changes while maximising opportunities requires an ecosystem approach (i.e. integration of research on soils, natural resources and biota). We provide this ecosystem view by modelling the linkages between above- and below- ground processes, and determining how they regulate carbon, water, nutrients and contaminants.

The Portfolio will also develop methods to optimise the match between land management and land capability. For example, through development of models, we will be able to predict where and when soil nitrogen saturation resulting from land use intensification will most likely occur, or may be avoided. We are also developing an improved understanding of how biological processes in diverse pasture systems could be used to improve efficiencies and help reduce soil nitrogen saturation and leaching.

Key Research Initiatives 2013/14

- Support MPI in developing a national strategy for managing wilding conifers, and assist regional councils and landowners in plans for managing wilding pines (Impact 1.2) *New initiative*
- Determine the resource-use-efficiency (water, nitrogen) of diverse pasture systems and demonstrate the benefits and services that can be derived from alternative land management (Impact 2.1) *New initiative*
- Predict the state and change of soil nitrogen to better assess the state and change of soil nitrogen to understand and improve the match between land use, management and capability for sustainable primary production (Impact 2.2) *Progressing a previous initiative*
- Assemble data sources and models to predict the long-term impacts of different land management on multiple ecosystem services – evidence needed by DOC to optimise conservation management for future prosperity (Impact 2.2) *New initiative building on previous work*
- Continue to determine the impact of intensification of dairying upon soil carbon and nitrogen cycling (Impact 2.2) *Continuing initiative*

Key Knowledge and Technology Transfer Activities

- Provide the Waimakariri Ecological and Landscape Restoration Alliance with monitoring protocols for tree reinvasion enabling the Alliance to evaluate progress in managing wilding conifers
- Develop a predictive model and map of current and potential soil nitrogen saturation and make it openly available for use through the National Land Resource Centre. The information will also be valuable for inclusion in nitrogen budgeting models such as Overseer[®]
- Provide the Lake Taupō Protection Trust and Taupō Lake Care Incorporated with information about nitrogen leaching from our large soil lysimeter array at Tihoi to enable these stakeholders to assign nitrogen leaching values to lucerne and improve nitrogen management in the Lake Taupō catchment
- Provide MPI with an assessment of the risk and opportunities of changes in soil services resulting from climate change – and identify the implications of this for land management adaptation

Research Collaboration

Key research partners include CRIs (AgResearch, Plant & Food Research, and ESR) and key researchers based in universities such as Stanford University, Swedish University of Agricultural Sciences, and the University of Waikato.

Measuring Biodiversity Change

This Portfolio will provide enhanced information on biodiversity in productive landscapes, and an objective methodology for biodiversity assessment of productive landscapes. Consistent, representative biodiversity data from both public and private land is essential to provide a comprehensive national overview of the state of New Zealand's biodiversity and to identify best management options.

We have worked with DOC and regional councils to develop consistent, robust frameworks for measuring, analysing and interpreting change in the status of biodiversity at a range of spatial and temporal scales. This supports international reporting requirements, benefits public and private conservation initiatives, and underpins a wide range of land management decisions.

The Portfolio will increase our understanding of trends in biodiversity and how such trends relate to natural ecosystem dynamics, diverse climate and soils, land use and invasive species (including effects of multiple weeds and pests interacting with each other). More robust measures of ecological integrity will also demonstrate the link to ecosystem services and assess the effectiveness and difference made by management interventions.

Other research in this Portfolio is using long-term data to evaluate how human activities affect biodiversity in Antarctica, and the impacts of climate change and fisheries on penguin populations. An area of relevance to Māori is our work with Ngātiwai Trust and the Tūhoe Tuawhenua Trust to develop meaningful, culturally-appropriate indicators to assess biodiversity.

Key Research Initiatives 2013/14

- Ensure that reporting of status and trends in key biodiversity indicators by DOC and regional councils is accepted nationally and overseas as robust and defensible, based upon peer-reviewed, internationally-published research (Impact 1.1) *Continuing – consolidating previous initiatives*
- Improve understanding of the interrelationships between soil biodiversity and dominant plant species (key drivers of biodiversity) across a gradient of soil nutrient availability so that point measurements can be scaled up for broad scale monitoring. Such insights will enable DOC to better prioritise and monitor management actions across the conservation estate (Impact 1.1) *New initiative building on previous research*
- Quantify biodiversity across a gradient of land use intensification so that managers of native forests, plantation forests, pastoral farms and vineyards will have information about several components of above- and below-ground biodiversity, collectively yielding a whole-catchment assessment of biodiversity (Impact 4.1) *New initiative building on previous research*

Key Knowledge and Technology Transfer Activities

- Increase end-users' ability to search and access the biodiversity data stored in the New Zealand National Vegetation Plot database (NVS) through the NVS website, which will be re-engineered to allow better metadata capture and delivery. This nationally (and internationally) significant database is used by researchers, local and central government agencies as a major information source for assessing and reporting on status and trend in New Zealand's plant biodiversity
- Work with two tangata whenua groups to develop biodiversity indicators that have meaning and usefulness to Māori, and work with iwi, DOC and regional councils on a process to ensure that these that are incorporated in local decision-making and reporting
- Provide DOC's Outcomes Management Office with data covering the status and trends in five key terrestrial biodiversity measures, enabling them to report on outcomes in their Annual Report

Research Collaboration

Key research partners include the University of Queensland, the Arthur Rylah Institute for Environmental Research (Australia), the University of Cambridge, the Swedish University of Agricultural Sciences, the University of Canterbury, University of Waikato (all are partners in various aspects of terrestrial biodiversity management); and NIWA and Antarctica New Zealand (sustaining the Ross Sea ecosystem).

Measuring Greenhouse Gases & Carbon Storage

To meet its international reporting obligations, New Zealand requires a robust inventory of net emissions and carbon storage in vegetation and soils. This Portfolio contributes to reducing uncertainties in national inventories and meeting international best practice, and hence reducing New Zealand's potential liability.

Our primary focus is on understanding the processes and drivers regulating greenhouse gas emissions from grassland, shrubland and forest, and developing modelling and analytical tools for assessing greenhouse gas emissions at farm to national scales. We also research innovative and practical technologies and strategies to mitigate emissions without reducing agricultural productivity.

Half of New Zealand's greenhouse gas emissions come from agricultural practices that produce methane and nitrous oxide. As these gases are emitted at landscape scales and atmospheric concentrations are very low, there are significant uncertainties in their measurement. When agriculture enters the Emissions Trading Scheme, New Zealand will need its own specific capacity to estimate nitrous oxide emissions (a long-lived gas with high warming potential) so it can report accurately and develop technologies to reduce these emissions.

Research has also improved estimates of future carbon stocks as a consequence of marginal pastoral grazing land reverting to shrubland, and more robust modelling of *Pinus radiata*, mānuka and kānuka under future climates. However more information is needed on how agricultural practices alter the amounts of carbon stored in soils. Māori interests centre on the potential for carbon sequestration on their lands.

Key Research Initiatives 2013/14

- Continue to test Methane Biofilters Prototype II to mitigate methane emissions from farm slurry ponds and also develop a novel technique for the simultaneous measurement of nitrous oxide and nitrogen gas to test potential mitigation options in future (Impact 3.2) *Continuing research*
- Continue to refine greenhouse gas emission models through better understanding of soil processes (Impact 3.1) *Continuing research*
- Continue development of novel techniques to improve understanding and estimation of farm-scale soil carbon stocks, and demonstrate the effect of plant functional richness on carbon sequestration, for farm-scale management of soil carbon and for more accurate national inventory (Impact 3.2) *Continuing research*
- Continue development of up-scaling techniques incorporating improved models of greenhouse gas emissions, carbon stocks and nitrogen cycling, to understand trade-offs and impacts of land-use change and intensification on greenhouse gas emissions and other ecosystem services (Impact 3.1) *Continuing research*
- Investigate the potential of stratified sampling strategies (using closed chambers) to reduce the uncertainty (due to high spatial variability) of nitrous oxide measurements in dairy grazed pasture and hence enable more accurate emissions estimates and improvements in experimental approaches (Impact 3.1) *New initiative building on previous work*

Key Knowledge and Technology Transfer Activities

- Work with the dairy industry to improve pasture nutrient management based on a range of process-based models (e.g. denitrification-decomposition) specific to New Zealand soils and climate to improve pasture management for the dairy industry
- Provide MPI and the fertiliser industry with more accurate estimates of nitrous oxide emission factors (EF1) from urea fertiliser and farm dairy effluent applied to dairy grazed pasture; this will improve the national inventory estimates of nitrous oxide emissions for UNFCCC reporting
- Provide MPI with improved estimates of regenerating shrubland carbon sequestration for inclusion in Emissions trading Scheme (ETS) look-up tables
- Work with NZ Beef & Lamb and MPI to improve hill country nitrous oxide emission estimates for national inventory reporting

Research Collaboration

Key research partners include AgResearch, NIWA, Lincoln University and Massey University (measurement and verification of greenhouse gas emissions); and Scion (carbon sequestration rates). We also contribute to the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC).

Partners in the NZAGRC include AgResearch, NIWA, Lincoln University and Massey University (measurement and verification of greenhouse gas emissions); and Scion (carbon sequestration rates).

The *Global Research Alliance (GRA)* brings 33 countries (Argentina, Australia, Brazil, Canada, Chile, China, Colombia, Costa Rica, Denmark, Finland, France, Germany, Ghana, Indonesia, Italy, Ireland, Japan, Malaysia, Mexico, the Netherlands, New Zealand, Norway, Peru, the Philippines, Republic of Korea, Spain, Sweden, Switzerland, Thailand, United Kingdom, United States, Uruguay, Vietnam) together to find ways to grow more food without growing greenhouse gas emissions.



Craig Ross, Carolyn Hedley and John Dando taking a soil core (*inset*) to assess soil carbon (*photo: Pierre Roudier*)

Characterising Land Resources

Data that characterise land resources are fundamental to all aspects of land-use monitoring, planning and decision-making by central and regional government agencies, industry sectors and land owners. Landcare Research is custodian of the National Soils Database and the New Zealand Land Resource Inventory that covers soil, land cover, land use potential, and ecosystem service information (see Appendix 1). This Portfolio's stewardship responsibilities include extending the coverage (spatial, temporal and thematic) and developing new frameworks for ensuring that our data is accessible, fit-for-purpose, and has sufficient quality assurance. Of particular relevance to Māori is our ongoing work in developing and piloting the web-based Māori Land Visualisation Tool. This Portfolio supports the National Land Resource Centre (page 6) and helps inform land use policy and resource management decision-making.

Last year, we produced Version 3 of the *National Land Cover Database* (LCDB3) in conjunction with key stakeholders – MBIE, MfE, LINZ, DOC, MPI and regional councils. This is a significant spatial dataset that supports a number of biodiversity assessments and land use planning. We are now working with the same stakeholders to produce the next version – LCDB4. In parallel, we are improving the generation of land cover information from satellite imagery to significantly reduce the cost of generating data for future versions of the LCDB. We are continuing to extend the geographic coverage of S-map (the national digital soil map) to areas prioritised by regional councils, and to ensure S-map supports the information needs of farmers, sector groups, consultants and government agencies. Soil variability significantly affects water storage, nutrient leaching and plant productivity. Accurate soil data underpin nutrient management tools (e.g., Overseer[®]), specialist crop calculators, the dairy effluent soil risk calculator, and precision irrigation.

At the catchment scale, we have developed a new method for allocating nutrient limits between farms by focusing more intensive mitigation practices on areas where there is a nitrate contamination problem, i.e. intensive land use on stonier soils in catchments known to have poor water quality. Future research will also support international reporting commitments, such as those relating to national carbon stocks.

Our work on the Environmental Domains classification for the Ross Sea Region of Antarctic was adopted by all Antarctic Treaty Partners. We are now working with Antarctica New Zealand to build on this work and develop a new portal to facilitate access to Antarctic data resources held by various agencies.

Key Research Initiatives 2013/14

- Enhance the delivery, utility and robustness of national land resource data assets – focusing on the New Zealand Land Resource Inventory (NZLRI) and Land Use Capability (LUC) – and begin work to enhance the National Soils Database to increase use and applicability for decision-making (Impact 2.1). *Ongoing initiative*
- Enhance the quality, spatial and thematic coverage of soil data in Hawkes Bay hill-country landscapes (leveraging off and contributing to Global Soil Map advancements) to demonstrate how regional councils, fertiliser companies and the agricultural industry can use soil variability data to improve agricultural land management in hill-country landscapes (Impact 2.1) *Progressing previous research*
- Pilot approaches, develop specifications and build consensus from stakeholders for the development of a national land use data set to enable central government and regional councils to easily understand and report on the implications of land use change (Impact 2.1) *New initiative building on previous work*
- Scale, synthesise and integrate models of ecosystem services (condition and trend) to catchment-scale to enable regional councils to understand the consequences of policy and planning decisions (Impact 2.1) *Continuing initiative*

Key Knowledge and Technology Transfer Activities

- Enhance the quality and provision of online services and access to key land resources (e.g. S-map On-line, Our Environment and LRIS Portal) for users in central government, local government, industry, researchers and the public.
- Develop a new portal that will facilitate better links between science and policy relating to the Antarctic Treaty System, and provide decision makers with better access to Antarctic environmental information
- Collaborate with MBIE, MfE, LINZ, MAF, DOC, NZ Fire Service and regional councils to develop the new edition of the Land Cover Database (LCDB4)
- Enable stakeholders to more easily meet best practice and regulatory requirements for water quality standards by increasing the interoperability of S-map and widely-used land management models, such as Overseer[®].

Research Collaboration

Key research partners include AgResearch, Scion and Plant & Food Research (the Soil and Land Use research alliance); CSIRO Land & Water (the Oceania Node of the Global Soil Map); and Antarctica New Zealand (Antarctic soils and environmental domains).



Ministry for the Environment Chief Executive, Dr Paul Reynolds opening the new National Land Resource Centre

Defining Land Biota

This portfolio is primarily responsible for the preservation, maintenance and development of five Nationally Significant Collections and Databases, authoritative identification of species, associated data-infrastructure, and related systematics research that underpins the scientific value of these biological collections and supports end-user needs. Although this Portfolio underpins all Outcomes, it contributes mainly to Outcomes 1 (Impact 1.1) and 4 (Impact 4.2).

Work is focused on five key areas: discovering, describing and interpreting New Zealand's biota; reconstructing the evolution of the biota; analysing biota properties and ethno-biology; managing and enhancing the collections; and developing information systems and products that ensure knowledge is more readily available to end users including other researchers. Research priorities are agreed on, and regularly reviewed, with key end user stakeholders – MPI, DOC, iwi, the Environmental Protection Agency (EPA), the Museum of New Zealand Te Papa Tongarewa and our own research staff.

Systematics research is of vital importance to biosecurity diagnostics and protecting New Zealand's primary production sectors and export/import trade. Strategic investment (last year) in building the new Beever Plant Pathology Facility will enable research to be safely undertaken on characterising pathogens that threaten biodiversity. The advent of high throughput DNA sequencing enables us to quickly identify newly-discovered pathogens such the devastating canker disease (Psa) in kiwifruit vines, and PTA disease of kauri. These DNA sequencing capabilities enable the development of tools to assist biosecurity agencies, e.g. for rapid identification of *Colletotrichum spp*, one of the top 20 most important disease causing pathogens in the world. Federated information infrastructures (e.g. the New Zealand Organism Register) and electronic Biota development (e.g. for user-friendly online identification keys) all provide opportunities for making flora, fauna and mycota information more readily available.

Research also contributes to improved knowledge of New Zealand's most threatened organisms, better biodiversity management, and improved understanding of taonga species. For example, and of particular relevance to Vision Mātauranga, we will lead an invertebrate survey to offshore islands within the rohe of the Ngātiwai Trust Board and train iwi students in collection and survey methods.

Key Research Initiatives 2013/14

- Publish on phylogeny and taxonomy of *Phytophthora* "taxon Agathis" (PTA) to underpin and enhance biosecurity policy, and to enable biosecurity agencies, exporters of wood products, the Kauri Dieback Joint Agency, iwi and other New Zealanders to better protect New Zealand's iconic kauri trees (Impact 1.1 and 4.2) *Progressing current research*
- Investigate the genetic diversity of *Botrytis* – the most important disease of grapes in New Zealand – to improve disease risk models and help biosecurity agencies and the wine industry to better manage fungicide use and avoid development of resistant populations (Impact 4.2) *New initiative developing previous research*
- Revise the threat status of the *Cardamine* (bittercress) species following the discovery and description of new species and a full revision of the genus. Improved information for New Zealand's threatened species and data deficient species lists underpin species conservation decisions of DOC and regional councils (Impact 1.1) *New addition to current research*
- Sequence and assemble the whole genome of a New Zealand stick insect (using NeSI resources) as part of research to determine how insects adapt to changing climates over evolutionary and ecological timescales. This project will develop skills in genomics that will be applied to various other scientific projects on the New Zealand biota (Impact 1.1 and 4.2) *Continuing research*
- Extend the electronic Biota of New Zealand to also cover the Gleicheniaceae, an important family of ferns. The e-Biota provides authoritative taxonomic and systematic information to support research, facilitate identification, underpin biodiversity reporting by DOC and regional councils, and assist threatened species management by DOC, MPI, iwi and regional councils (Impact 1.1) *New addition to ongoing work*

Key Knowledge and Technology Transfer Activities

- Provide authoritative identifications, diagnostic and information services on plants, invertebrates, fungi and bacteria for biodiversity and biosecurity managers, iwi, other CRIs and researchers
- Make unwanted organisms status data from MPI and 'Threat Classification' status data from DOC available to biodiversity and biosecurity managers through the New Zealand Organism Register (NZOR), improving the utility of NZOR for key end users
- Make information and material from the New Zealand Flax Collection available to iwi, weavers, and other New Zealanders working with flax
- Provide improved search and download facilities for collection data for a wide range of collection users via a new version of the Systematics Collections Data website
[/www.landcareresearch.co.nz/resources/data/systematics-collections-data](http://www.landcareresearch.co.nz/resources/data/systematics-collections-data)
- Make digitised type specimens of plants and insects available to a wide range of systematics researchers through the Systematics Collections Data website

Research Collaboration

Key research partners include Te Papa Tongarewa (plant systematics); Te Papa Tongarewa and NIWA (New Zealand Organisms Register – NZOR; electronic Flora); the Allan Wilson Centre (evolutionary pathways); Plant & Food Research (*Botrytis* genetics) and Auckland Museum, Scion, University of Canterbury, Massey University, Lincoln University, University of Otago, University of Waikato and Australia's Virtual Herbarium partners.



Ines Schoenberger at the function to mark the \$1.2m refurbishment of the Allan Herbarium

Vision Mātauranga

Goal

Landcare Research is a key, preferred partner for Māori in enhancing the sustainable value of Aotearoa's land-based natural resources

Context

Vision Mātauranga is a Government initiative aimed at unlocking the innovation potential of Māori through knowledge, resources and people. Landcare Research's Core Purpose is strongly aligned to this – our research is strongly aligned with the way in which Māori link economic, community and cultural well-being with that of the natural environment. We also recognise the need to support Māori endeavour to “paddle their own waka” and not rely on others to do so on their behalf.

Landcare Research has a strong 20-year history of successfully partnering with iwi on a variety of research programmes. Initially our focus was on specific projects with Māori organisations and included developing geographic information systems (GIS) to document cultural values and interests, and protecting and restoring particular taonga species such as kiwi in the Te Urewera National Park.

Increasingly we are working in a more strategic way with Māori organisations across a breadth of issues. Māori organisations at different stages in their Treaty of Waitangi settlement processes have quite different science needs. Our partnerships, spanning various Portfolios, focus on meeting the needs of particular iwi.

Strategic focus 2013/14

We are committed to maintaining and developing long-term collaborative relationships with Māori in ways that support the Vision Mātauranga concept:

- A major new Core-funded, cross-Portfolio initiative will focus on Māori aspirations for conservation lands. This will determine how to achieve biodiversity outcomes while enhancing the livelihoods of Māori communities across the four themes of Vision mātauranga – indigenous innovation, taiao (environment), hauora (health and wellbeing) and mātauranga (knowledge). The project is wide-ranging and encompasses structures (e.g., roles, systems and scales of governance and co-management relating to Tūhoe settlement of Te Urewera National Park); economic benefits from environmental and cultural branding; and cultural indicators and measures for assessing status and trends in biodiversity and ecosystem services.
- Progress a sustainable business model for co-investment to maintain and develop the prototype Māori Land Visualisation Tool. This was developed previously with Te Puni Kōkiri (TPK), Office of the Māori Trustee, MPI, MBIE, Ministry of Justice / Māori Land Court, Land Information New Zealand (LINZ) and DOC. With the support of these stakeholders, we will enhance the Tool and pilot it with a selection of Māori land blocks.
- In a new initiative, we are collaborating with Fonterra, ZESPRI, Massey University, the Federation of Māori Authorities (FOMA), the Māori Trustee, DairyNZ and Beef + Lamb NZ on a project to increase the productivity of Māori land – Te Kōkiri mō te Whaingā Hua o Ngā Whenua Māori. The initiative is the private sector's response to the Māori Economic Development strategy “He Kai kei aku ringa”, produced by the Māori Economic Development Taskforce. We are currently the only CRI invited to participate in this private sector initiative. Our role is to provide advice on the role of science and technology in underpinning sustainable land use, identify potential new opportunities and develop a decision support system for enabling Māori landowners to make better-informed decisions regarding land use.

We will continue to progress collaborations with our established partners, building on current initiatives:

- *Recognise Māori aspirations for economic, cultural and social development (e.g., governance and co-management of Te Urewera by Tūhoe; opportunities for carbon farming on Ngāti Porou marginal hill country); the Māori Land Visualisation Tool (national)*

- *Protect taonga and cultural values through the delivery of science* (e.g. reinstatement of sustainable customary harvesting of kuia chicks and population monitoring of grey-faced petrels breeding in the Hauraki Gulf (Ngāti Awa))
- *Conserve natural resources important to Māori while balancing economic development opportunities that might be derived from those resources* (e.g., indigenous restoration forestry with Tūhoe Tuawhenua trust; custodianship of the National Flax Collection, including providing divisions, advice and services)
- *Maximise the integration of traditional knowledge and contemporary science* (e.g., kaitiakitanga and biodiversity research; biodiversity management in Te Urewera (Tūhoe); mātauranga Māori informed wetland restoration (Waikato); mātauranga Māori based monitoring approaches and methods for water quality monitoring (Kaipara, Manawatū); mātauranga Māori informed freshwater policy (Auckland region))

Throughout our work with iwi, our goal is to enable our own staff to fully understand the particular tikanga (customs) important to Māori. We will support this by:

- Better integrating our Māori strategy throughout our research portfolios and the wider company
- Continuing to build Māori research capability within and external to Landcare Research (through recruitment and training) that contributes, amongst other things, to addressing the shortage of Māori engaged in science research
- Reinforcing the internal bi-cultural framework that Landcare Research has built up over the years, and for which it has become widely known and respected.

Key Performance Indicator

- Number of positive strategic partnerships in which we are linking science and mātauranga Māori in projects with iwi and Māori organisations and which address Māori goals and aspirations.

Science Excellence & Collaboration

Goal

Landcare Research is recognised nationally and internationally for excellent science collaborative research with CRIs, universities and other organisations, including those overseas.

Context

Sustaining the research capabilities that are critical for achieving our National Outcomes and maintaining our science excellence against the background of flat or falling revenues from the public sector is challenging. To achieve this, we are refreshing the breadth of our research activity to focus on research that is more strongly aligned with our Core Purpose. We are also making new appointments to enhance our capability in research areas that are critical to our strategy for intended growth into new, high priority areas.

International Connectedness and Reputation

International competition for talented environmental scientists is increasingly fierce, making it a constant challenge for New Zealand research organisations to attract and retain the best and brightest. Collaboration both within New Zealand and with overseas organisations is a necessary strategy to grow the pool of skills and innovative thinking that we can access.

Because of our reputation in pest management, we were invited to join the Invasive Animals Cooperative Research Centre (CRC), an AU\$19.7M programme spanning all aspects of terrestrial and freshwater vertebrate pest species. As Australia and New Zealand have many pest issues in common, shared expertise and collaborative research will benefit both countries. Initial participation was supported through strategic investment but research is now funded from operational budgets; it is expected to enable significant new opportunities.

Many of Landcare Research's scientists are recognised internationally for their skills and expertise, including the quality of scientific papers in high impact peer-reviewed journals. More than 60% of our papers are published collaboratively with overseas colleagues from many countries. A large number of our best scientists hold positions on editorial boards of international and national scientific journals. Recognition of the major contributions of our scientists is confirmed by invitations as keynote speakers at national and international conferences. One of our senior scientists was elected as a Fellow of the Royal Society of New Zealand, and another elected as a Fellow of the New Zealand Institute of Agricultural and Horticultural Science.

Our scientists are invited onto many important international and national panels, advisory boards and technical working groups. In early 2013, one of our scientists was among just 25 scientists from around the world to be elected to the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). IPBES represents 90 governments and is expected to be a leading global body providing scientifically sound and relevant information to support more informed decisions on how biodiversity and ecosystem services are conserved and used around the world.

One of our key senior soil scientists leads the Oceania node of the Global Soil Map, a significant international project that will assist in addressing global issues such as food and water security, climate change and environmental degradation. There are significant two-way synergies between the Global Soil Map and S-map (the digital soil map for all of New Zealand) that Landcare Research is developing.

Strategic Focus 2013/14

- We will track the quality of our science performance against relevant national and international benchmarking sources. This will complement evaluation of our research impact and support ongoing monitoring of our science performance by MBIE, stakeholder partners and peer review.
- We will use our *Science Advisory Panel*, which consists of internationally-respected scientists, to evaluate our research Portfolios (primarily in regard to science excellence and strategy) and to recommend areas for

improvement. The Panel provides a strategic overview, global perspective and have an appreciation of the New Zealand context. They meet in person with the Board once a year and by video or phone conference once a year.

Maintaining and Developing Science Capability

The Chief Scientist and Science Team Leaders manage the changing capability and capacity needs of the Portfolios. Where potential gaps are identified, we partner with other research providers in New Zealand and offshore; recruit new staff with the required expertise; and enable our staff to develop new capabilities through training opportunities both nationally and internationally. Many of our scientists are supervisors and co-supervisors for postgraduate students at New Zealand universities.

An important key to succession planning and fostering talent is identifying the true intellectual entrepreneur at an early stage and building around them. Evidence suggests these individuals do produce the most impactful research.

To maintain key capabilities in the face of falling government investment in some strategic areas of environmental science, we invest a subset of our Core Funding in capability-building science projects of 1–2-year duration. Such projects also develop talent and new research ideas, such as those that will be needed to meet the National Science Challenges.

Global Change and Trade

Continuing strategic investment

We have made significant progress in building capability (especially in relation to high performance computing) and developing new tools aligned to Outcome 4; this work is central to future efforts to integrate knowledge of global change impacts with its economic repercussions for New Zealand.

We are now finalising forest productivity simulations, including investigating how alternative management strategies perform under a changing climate and quantifying important uncertainties around these results – a significant step forward from previous simulation studies carried out in New Zealand. New work will focus on developing a spatially detailed and dynamic economic model of land-based production in New Zealand.

The Computation Institute and University of Chicago provide total direct in-kind contributions valued at US\$150k, at least US\$200k for supercomputing resources plus substantial (but un-quantified) indirect in-kind contributions through their ongoing related research projects. For example, we have exclusive access to the results of global-scale simulation studies that the University of Chicago are conducting on climate impacts on crop yields. These have proven invaluable in a related project on global integrated assessment modelling that is funded by MPI.

We expect increasing spill-overs from this project to other areas of mutual interest to Landcare Research and the Computation Institute. In the longer term, we also expect to benefit from some of the many research linkages that the Computation Institute has within the University of Chicago, elsewhere within the United States, and internationally.

Collaborative Research Centres, Networks and Consortia

Landcare Research is a partner in several collaborative research centres, networks and consortia (Appendix 2) that pool capability in science areas relevant to the scope of our operations as outlined in our Statement of Core Purpose. We have also we been invited to join the B3 (Better Border Biosecurity) collaboration and the Massey-based Agri-Food Innovation Cluster.

In areas of our core capability, Landcare Research partners with New Zealand government agencies (MPI, DOC, MFAT, MBIE) and international funders (private sector, philanthropists, NGOs, national governments and donors) on science projects across many countries in South America, SE Asia, the Pacific, China and Korea. Such collaboration helps realise opportunities for New Zealand through support for trade and diplomacy, and also through the knowledge and experience that we bring back to New Zealand.

Joint Graduate Schools and Co-appointments with Universities

We are committed to increasing our links with universities in order to grow sector capabilities through the involvement of staff and graduates in collaborative research programmes and technology transfer. We are working with New Zealand universities to: develop more strategic opportunities for placements for summer students within our research programmes; develop specific, short courses for professionals; supervision of postgraduate students working within our research programmes; co-appointments; and staff secondments in both directions.

We continue our commitment to the Joint Graduate School (focused on biosecurity and biodiversity) with the University of Auckland. Three of our staff hold Professorial or Associate Professorial part-time roles at the University, and we intend to increase this to involve five of our staff with a broader focus of capability. Opportunities for much closer collaboration with Lincoln University are emerging from plans for the Productive Land Innovation Hub and we have established joint appointments for two researchers – one from Lincoln University and one of our staff. Another senior scientist has been appointed as an Honorary Professor at the University of Otago.

We continue to foster relationships with universities in Chile, India and China, promoting opportunities for collaborative research. One of our senior scientists at Palmerston North holds a Professorial Chair in Environmental Science, a joint appointment with Massey University that also comprises a tripartite agreement with the Punjab Agricultural University, India.

Key Performance Indicators

- Number and percentage of joint scientific peer-reviewed publications and IP outputs with other New Zealand or international research institutions per annum (*MBIE indicator*)
- Total number of international awards, significant New Zealand awards, invitations to participate on international committees, and editorial boards for the CRI's published papers, per annum (*MBIE indicator*)
- Proportion of published papers in the top 25 international journals relevant to the scope of Landcare Research (as outlined in the Statement of Core Purpose, page 4) per annum (*MBIE indicator*)
- Total number of citations per CRI published paper (*MBIE indicator*)
- Percentage of relevant national and international research providers that have a high level of confidence in Landcare Research's ability to form the best teams to deliver on the its Outcomes (*MBIE indicator with data provided from their external survey; the 2012 survey found 91% of respondents had confidence in our ability to put together the most appropriate research teams*)
- Total dollar value of revenue (in cash), and dollar value subcontracted out to other organisations from each 'source category' per annum from rolling three years (*MBIE indicator*)

Informatics & Digital Strategy

Goal

Landcare Research's science knowledge, databases and collections, analyses and modelling are readily available and can be used efficiently and effectively.

Context

Accessibility of information and knowledge is the key to an effective innovation and is a major requirement of our work. Policy and funding agencies increasingly depend on e-science and robust integrative modelling across local, national and even global scales. The private sector also needs to be able to derive different and new value from publicly funded datasets. We have established an Information Governance Group with responsibility for developing an overarching Digital Strategy to guide investment in our digital systems and services to enable our transformation into a digitally-rich science organisation.

Informatics is the design and development of information systems that can gather, manage and process huge quantities of complex data (often from distributed sources) and deliver information as and when needed, often through web portals. Key underlying principles for web portals are that data are ethically-open (discoverable) and conform to international data standards and in forms that are usable by humans and computers. These developments are being enabled by high network speeds, such as the ultra-fast KAREN (Kiwi Advanced Research & Education Network) and the High Performance Computing facilities being built and managed by National e-Science Infrastructure (NeSI) investment. A key focus is *Interoperability standards* – ensuring our computer systems work seamlessly alongside those of our national and international stakeholders.

Landcare Research is custodian of and curates seven 'Nationally Significant' biological, soil and natural resource databases and collections (listed in Appendix 1) – the largest holding for any of the CRIs, and larger than equivalent collections held by museums in New Zealand. The New Zealand Organisms Register (NZOR) is an excellent example of the contribution that our informatics capability has made in increasing the accessibility to data from our biological collections plus those managed by NIWA and Te Papa Tongarewa. NZOR creates one dynamic, freely-available virtual national resource. Data can be directly integrated into biodiversity and biosecurity systems used by central government ministries, departments, and agencies, local government, research institutes, NGOs and the wider community. NZOR aligns with Open Government policies and fits within emerging e-Government initiatives.

Landcare Research led the design and development of the NZOR, which is the most complete digital species catalogue of any country, and the infrastructure is unique. It represents a significant national contribution to global efforts such as the Catalogue of Life, the Global Biodiversity Information Facility (GBIF) and Group on Earth Observations Biodiversity Observation Network (GEO BON), to support evidence-based reporting of the status and trend of biodiversity globally.

National e-Science Initiative (NeSI)

Continuing strategic investment

We are partners in the \$48M National e-Science Infrastructure (NeSI) investment by Government, three universities and one other CRI to build and operate four High Performance Computing facilities. NeSI will enable us to carry out advanced modelling across all four of our National Outcome areas for applications such as land and ecosystem resource inventories, historic ecosystems, physical and economic climate change impacts, and invasive species). It will also facilitate collaborations with researchers overseas.

NeSI has opened up wide-ranging opportunities to undertake projects that previously would have been too time-consuming and too expensive to even contemplate. Examples of such computationally-intense projects include:

- Processing single species and population genomics (benefitting biosecurity and conservation management)
- Simultaneously analysing clusters of 7000–19 000 vegetation plots recorded in NVS to develop a robust, impartial quantitative classification of New Zealand's plant communities
- Remote sensing data processing (e.g., cloud masking, satellite image mosaicking, image feature segmentation) for the Land Cover Database project, enabling LCDB3 to be completed in a remarkably- short time frame
- Pest population modelling at the national scale (ultimately multi-species population modelling will be required for Predator-free New Zealand)

Data Management and Data Warehouse

Previously strategic investment, now funded operationally

Our two projects – *Research Data Management* and *Data Warehouse for Environmental Modelling* – are essential to making data increasingly accessible to end-users, advancing environmental modelling capability and meeting the needs for emerging policy and practices. The Research Data Management project is critical to ensure we meet rapidly evolving global standards in data management to reduce risk exposure from data inaccuracies and to provide credibility for our contractual obligations when presenting data.

The Data Warehouse for Environmental Modelling project, SCENZ-Grid, will provide a platform for much of our spatial data, environmental modelling research and opportunities offered by NeSI. The platform underpins S-map contributions to the Global Soil Map (www.globalsoilmap.net) and the development of an international standard soils data model that incorporates measurement standards and uncertainty. The platform is critical to developing the new Antarctic Web Portal to provide users with ready access to all data collected from Antarctic research.

Strategic Focus 2013/14

The Informatics Strategy underpins all four of our National Outcome investment strategies and supports all ten of our research Portfolios. Research priorities are:

- *Data lifecycle management*: improving the infrastructure and culture for managing our data and data integrity, from initial collection to end-use and ongoing storage
- *Managing land and water data uncertainty for credible evidence-based solutions*: greater awareness and transparency about the uncertainties and risks associated with data according to how it was collected and managed
- *Computational models*: integrating disparate datasets for more sophisticated and rigorous modelling of complex environmental-economic-social scenarios
- *Research web-delivery*: enhancing accessibility and user-experience of our data through web delivery (portals, e.g. for Antarctic New Zealand, NZOR)

Key Performance Indicators

- Client surveys show satisfaction with our informatics initiatives (*Landcare Research user online surveys*)
- Percentage change in the number of requests, enquiries and transactions for Landcare Research's publicly available databases and collections (*MBIE indicator*)

Commercialisation of Technology

Goal

Landcare Research adds value to the New Zealand economy through commercially viable products and services and their transfer to partners in the private sector.

Context

CRIs are encouraged to transfer commercially-viable technology and knowledge to the private sector at an early stage instead of committing capital to start-up businesses. Landcare Research draws on New Zealand's existing commercialisation capacity through the National Network of Commercialisation Centres (NNCCs) – specifically we use the services and resources available through Auckland UniServices' Return on Science programme and we are a shareholder in KiwiNet. We similarly expect to be able to draw on the resources of Callaghan Innovation to get new technology applications market ready.

Over recent years, we have developed Enviro-Mark[®] and our subsidiary company carboNZero Holdings to provide scientifically-sound commercial certification services to clients in New Zealand and overseas. We regularly review commercial business ownership, value and related risk issues.

Enviro-Mark offers multi-level environmental management systems to over 180 clients involving over 300 sites in New Zealand, and so contributes directly to Outcome 4. Enviro-Mark's focus for the next five years is to provide continuing support to long-term members helping them mature their environmental management systems. New opportunities for Enviro-Mark clients include the integration of new measures (e.g., social sustainability, biodiversity and ecosystem services) into formal environmental management systems. Sustainable business communities are increasingly recognising the importance of these measures to their license to operate. The new opportunities will be developed and offered as a specific service based on Landcare Research's expertise.

Internal review and restructuring of carboNZero Holdings Limited has led to improvements in its financial performance and a significant growth in certifications. Investment in a new software platform will enable the development of additional environmental certification products beyond carbon, and hence more integrated services for clients. carboNZero Holdings is exploring options to strengthen and grow the business, extend product offerings and increase value for clients.

A process is under way to enhance the links between our carboNZero Holdings and Enviro-Mark environmental certification programmes to provide a more coherent and enlarged set of services to clients in New Zealand and overseas.

Strategic Focus 2013/14

Landcare Research will enhance its approach to creating environmental solutions and up-scaling their availability through commercial channels. We will:

- Work with KiwiNet and Auckland UniServices to explore commercialisation potential of new rodenticides, technology that matches precision irrigation to paddock scale soil variability, and a new method of installing lysimeters (to monitor ground water drainage and nitrogenous leachate with minimal ground disturbance)
- Seek external investment to grow the global business of the carboNZero^{Cert™} programme, which was corporatised in 2011 and is currently our wholly-owned subsidiary
- Continue to develop the Enviro-Mark environmental management and certification programme specifically to meet the needs of the New Zealand businesses. We will seek to extend the programme to enable its members to access green growth opportunities through our science
- Transfer commercially-viable products and services to the private sector via licensing, IP sale and use of start-up business. In doing so we will seek investor capital and financial risk-sharing for the establishment years, making use of the services of the National Network of Commercialisation Centres
- Engage with Callaghan Innovation to explore opportunities relating to our development of new applications from high-technology research such as remote sensing, informatics, soil mapping and precision irrigation

Key Performance Indicators

- Total number and percentage of licensing deals of Landcare Research-derived IP (including technologies, products and services) with New Zealand and international partners per annum (*MBIE indicator*)
- Percentage of relevant end-users who have adopted knowledge and / or technology from Landcare Research (*MBIE indicator with data provided from their external client survey; the 2012 survey found 97% of respondents have adopted our knowledge or technology in the past three years*)



Cleaning products manufacturer eco planet is an Enviro-Mark programme member.

International Engagement

Goal

Landcare Research's science excellence is enhanced, and opportunities are realised for the benefit of New Zealand, by managing and leveraging international connections.

Context

Landcare Research, in partnership with our key stakeholders, is recognised as a world-leader in areas of biosecurity, pest management, agricultural greenhouse gases, geospatial and biodiversity informatics, and integrating multidisciplinary science to inform decision making. Our researchers are internationally well-connected and collaborate extensively with overseas colleagues on issues aligned to our Core Purpose and where benefit to New Zealand will eventuate.

The New Zealand Government has prioritised India, China, Australia, Korea, Singapore and others for development of trade and science ties. Science is increasingly being used to spearhead diplomacy in trade and find solutions for global issues (e.g. the Convention on Biological Diversity, the Antarctic Treaty). The demand for linked economic - environmental modelling of global change and trade (page 39) is growing rapidly, and there is an acute need for international engagement and collaboration.

There is a need to foster in-country collaborative partnerships, building capability through staff exchanges and developing a business model in which our contribution is focused on providing consultancy advice and programme assessment rather than programme delivery.

Strategic Focus 2013/14

- We will continue to collaborate internationally to ensure science and organisational excellence through the two-way flow of knowledge and staff, and shared state-of-the-art-technologies.
- We will support New Zealand's multilateral/bilateral environmental commitments, trade agreements and exporting businesses by providing expert scientific input and perspective on global issues such as greenhouse gases and biodiversity. Similarly, we will have a foresight role interpreting overseas trends in environmental reporting, policies, standards and market expectations, and developing solutions for New Zealand.
- We will grow our international revenue and services from both our science and the carboNZero^{Cert™} programme. The latter has a role in sourcing knowledge from overseas markets to help direct our science and commercial services for New Zealand's benefit
- We will support New Zealand's Official Development Assistance in Pacific Island Countries through capacity-building projects in natural resource management, climate change science, biosecurity, and management of national biological collections and their application for economic benefit.

Key Performance Indicators

- Total number of partnering deals (including licensing agreements) for Landcare Research-derived IP (including technologies, products and services) with international partners per annum (*MSI indicator*)
- Percentage of total revenue from international sources per annum

People, Learning & Culture

Goal

Landcare Research has an organisational culture that is adaptive in the face of change, attracts high quality talent, produces great leaders and which is supported by effective systems and processes.

Context and Strategic Focus 2013/14

We will work closely with the other CRIs to establish greater effectiveness and efficiency through shared approaches, systems and – where appropriate – physical resources.

- *Workplace culture:* Our workplace culture, our philosophy of manaaki tangata – manaaki whenua, and our science facilities all play a vital role in attracting and retaining staff. We will focus on creating stronger alignment between our values, behaviours and the organisation's strategies, and embed this in our organisational culture. After two consecutive years of implementing a staff survey to assess our organisational culture, employee engagement and leadership capability, we will now undertake the survey biennially (in line with other CRIs)
- *Leadership:* We have been participating in the development of a pan-CRI approach to leadership development. This aims to achieve efficiency gains and greater effectiveness through closer alignment and more effective collaboration around executive and senior level development. A pan-CRI leadership framework was signed off by the Science New Zealand Board in December 2012 and the GM group are now working on programme design.
- *Talent:* Other pan-CRI human resources projects include workforce planning, recruitment, career paths, succession planning, and science capability – all of which contribute to the area of talent management. Each of these projects is likely to yield mutual benefits when done in an integrated way. A set of recommendations for each has been approved by the Science New Zealand Board, and are either currently being implemented across the CRIs or are in the final stages of development. A new performance appraisal and development process has also been rolled out across the organisation to ensure individual development plans are in place for all staff.
- *Compliance, Systems and Service:* Where possible, we collaborate with other CRIs on initiatives to improve our systems, policies, processes and workplace, (e.g. health and safety, workforce analytics, information systems, and procurement). We maintain a strong focus on compliance with all good employer legislation; we are a member of the EEO Trust; and we support the Mainstream Programme for people with disabilities. We have tertiary (the highest) accreditation in ACC's Workplace Safety Management Practices (WSMP) programme.

Key Performance Indicators

Culture and leadership

- Staff survey evaluations of leadership, engagement and organisational culture.
- The number and percentage of staff in leadership positions completing the leadership development programme and demonstrating improved leadership evaluations.
- Bicultural Learning & Development Strategy in place and implemented.

Talent management

- Turnover of key staff.
- Capability management plans in place for all teams.
- Individual performance and development plans in place of all staff.

Good employer

- 'Good employer' performance will be covered in comprehensive annual sustainability reporting on our website (www.landcareresearch.co.nz/sustainability).

Corporate Sustainability

Goal

Landcare Research continues to be recognised as a leader in corporate sustainability in New Zealand.

Context

Landcare Research remains committed to corporate sustainability, seeking continuous improvement through targeted activities to support material issues such as our good employer status, community and cultural inclusiveness, economic efficiency, financial viability, and minimising and mitigating the adverse effects of our activities on the environment. In procurement, we make significant use of All-of-Government contracts, pan CRI contracts and syndicated contracts, plus we have made improvements in our own supply contracts. These improvements span both collaborative and general contracts, with emphasis (and best gains) on collaborative initiatives.

Comprehensive, evidence-based reporting continues via our sustainability web pages. These pages cover our environmental, good employer and social performance and makes links with our science and with Māori perspectives on sustainability. www.landcareresearch.co.nz/about/sustainability

We are members of

- Business NZ and the Sustainable Business Council (SBC), including CEO membership of the Executive Committee of SBC and Landcare Research acting as GRI data partners with BusinessNZ.
- The Sustainable Business Network
- The EEO Trust
- The New Zealand Green Building Council

Our subsidiary carboNZero Holdings and our Enviro-Mark programme provide services to a very wide range of businesses spanning many sectors. They report their influence and impact in success stories and news items on their websites www.carbonzero.co.nz www.enviromark.co.nz

Strategic Initiatives

- We support the Sustainable Business Council group of companies by encouraging uptake of the core set of indicators by companies across New Zealand, and reporting our own performance using these metrics
- We collaborate with CRIs and government agencies to drive improvements in procurement and property management practices to reduce risk and increase business efficiency within our organisation and across a wide cross section of businesses in our supply chains
- We support and contribute to CRI leadership in \$65m laboratory supply syndicated contracts for 37 government agencies including CRIs, district health boards, universities and MPI to deliver service improvements and cost savings directly benefit science, government and New Zealand

Key Performance Indicators

- Retain ISO14001 certification for our environmental management system and practices
- Retain tertiary accreditation (the highest level) in the Accident Compensation Commission (ACC)'s programme for Workplace Safety Management Practices
- Retain carboNZero^{Cert™} certification
- Improved supply contracts delivering measurable business benefits

Financial Strategy & Metrics

Goals

Financial viability and flexibility

Landcare Research continues to maintain financial viability and flexibility (including meeting our shareholders' expectations on return on equity), operates within our banking covenants, and invests for the future in both infrastructure and strategic initiatives.

Return on equity

Achieve and maintain an adequate return on equity in our core science business. Surpluses may be used to support our commercialisation businesses and strategic initiatives to enhance our science. A tailored rate of return will be agreed during the annual planning process with our shareholding Ministers.

Context

Financial flexibility is important to enable Landcare Research to respond to changes in the external environment and pursue strategic opportunities.

In determining an acceptable tailored rate of return we have adopted the following underlying principles:

- In the long term the rate of return on equity should equal the weighted average cost of capital
- In the short term the Board is prepared to accept a lower tailored return on equity to support strategic investment that will enhance science, provide benefit to New Zealand and underpin future returns, including the development of our commercial businesses
- The targeted return on equity will be reviewed by the Board over the planning period as other strategic investment opportunities with long term benefits are presented

In the current fiscal situation we are conscious that it is unlikely there will be increases in Government funding for science research. The Core Funding Agreement provides a degree of certainty, but no recovery of inflation; and we expect strong competition in the science sector for other sources of government and private sector revenue. Critical to the ongoing success of Landcare Research will be our ability to ensure financial viability through a sustained period of fiscal pressure.

Financial Operating Plan 2014–18

The Operating Plan shows the continuous improvement in financial performance.

Financial Performance and Position

<i>For year ending 30 June:</i>	2013		2014	2015	2016	2017	2018
	Target	Forecast	Target	Target	Target	Target	Target
Revenue - Consolidated	59.0	56.3	55.7	57.1	58.6	60.1	61.7
EBIT before Investment & Restructure - Consolidated	3.4	3.1	2.2	2.4	2.5	2.8	3.4
EBIT before Investment - Consolidated	3.3	2.5	2.2	2.3	2.4	2.7	3.3
EBIT - Consolidated	1.6	1.0	1.5	1.9	2.1	2.5	3.2
Assets, \$m	43.6	44.1	43.3	46.0	47.0	48.7	50.1
Investment	1.80	1.5	0.7	0.4	0.3	0.2	0.2
Dividend \$m	0	0	0	0.4	0.7	0.8	1.0
Equity ratio	64.1%	63.0%	66.5%	64.9%	65.3%	65.2%	66.1%
Gearing	0.0%	15.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Explanatory notes to table:

Revenue is projected to decline during the 2014 financial year. Over the planning period, minor or modest increases are expected in science research revenues, and higher growth is anticipated in our commercial business revenues.

EBIT is projected to decrease in 2013 due to declining revenues and restructuring costs. (*EBIT*: Earnings before interest, financial lease charges and tax, and after committed business development expenditure and technology service expenditure)

Assets are projected to increase over the planning period as deferred building infrastructure issues are addressed. Further earthquake strengthening is budgeted in 2014/15 for a key building at our Lincoln site.

Investments are projected to decrease over the planning period due to affordability.

The Board proposes to withhold payment of a dividend to enable funding of strategic investment projects, contingent upon shareholder assent.

Equity ratio: Average shareholders' funds ÷ Average total assets.

The debt *gearing* ratio over the planning period remains within the acceptable range. (*Gearing* is Interest bearing debt ÷ Interest bearing debt + Shareholders' funds, expressed as a percentage.)

Re-investment of Surplus

Landcare Research is continuing with a number of identified strategic investment opportunities that will create future value. In determining the amount available for strategic investment we have adopted the following principle:

- We are prepared to reinvest surpluses in strategic investment opportunities that will create long term benefits provided we have both capacity to invest and Landcare Research's long term rate of return at least equals our weighted average cost of capital.

During the planning period, we intend to reinvest surpluses with an EBIT impact of \$0.2 – \$0.8 M p.a. into strategic investments. This will be financed from both science research surplus and the performance of prior investments.

Strategic investment opportunities planned for 2013/14 include the following initiatives committed to in previous years:

- The Pathogen Facility in Auckland (residual payment for completion of building contract)
- Economic modelling capability for global change and trade (page 39)
- NeSI (page 41)

Key Performance Indicators (as specified by MBIE)

Financial indicators Landcare Research Group show continuous improvement in efficiency, while maintaining growth, investment and appropriate levels of risk.

	Actual	Forecast	Business Plan				
For year ending 30 June:	2012	2013	2014	2015	2016	2017	2018
<i>Efficiency:</i>							
Operating margin	11.0%	9.4%	10.0%	10.5%	10.7%	10.9%	11.2%
Operating margin per FTE	\$16,963	\$14,406	\$16,263	\$17,442	\$18,213	\$19,031	\$20,208
<i>Risk:</i>							
Quick ratio	0.80	0.48	0.72	0.69	0.62	0.71	0.80
Interest coverage	47.5	35.2	35.6	N/A	N/A	N/A	N/A
Operating margin volatility	10.8%	9.9%	10.8%	10.9%	7.7%	8.4%	8.2%
Forecasting risk	1.1%	0.4%	0.6%	0.8%	0.2%	0.2%	-0.2%
<i>Tailored Rate of Return:</i>							
RoE before Investment & Restructure	8.3%	7.7%	5.4%	6.1%	6.1%	6.7%	7.9%
RoE before Investment	8.2%	6.0%	5.4%	5.8%	5.9%	6.5%	7.7%
RoE NPAT	4.9%	2.2%	3.5%	4.9%	5.2%	6.0%	7.3%
<i>Growth/Investment:</i>							
Revenue growth	-7.9%	-3.6%	-4.6%	2.5%	2.6%	2.5%	2.6%
Capital renewal	1.5	2.1	0.6	1.5	1.4	1.0	1.0

NA = not applicable

*Return on equity excludes impact of legislative change regarding depreciation on buildings and fair value gains/ (losses)

Explanatory notes to table:

Operating Margin: EBITDAF ÷ Revenue, expressed as a percentage and per FTE (*EBITDAF* is Earnings Before Income Tax before Depreciation, Amortisation and Fair value adjustments)

Quick ratio: (Current assets – Inventory - Prepayments) ÷ (Current liabilities – Revenue in advance)

Interest cover: EBITDAF ÷ Interest paid

Forecasting Risk: 5-year average of return on equity less forecast return on equity

Return on equity: NPAT ÷ average shareholders' funds, expressed as a percentage (*NPAT* is net profit after tax)

Shareholders' funds: Includes share capital and retained earnings

Capital renewal: Capital expenditure ÷ depreciation expense plus amortisation expense

Financial Viability and Flexibility

Landcare Research's projected financial performance declines in 2013/14 but improves over the planning period, and a strong balance sheet provides flexibility. Our modelling of potential revenue shortfall has identified actions to minimise and mitigate the potential impacts. We are fully compliant with banking covenants.

Return on Equity

Landcare Research's tailored return on equity for 2013/14 is 3.5%, which has enabled strategic investment to continue in areas approved by the Board of Directors (to be negotiated with shareholding Ministers).

Statutory Reporting

Goal

Landcare Research's reporting of its corporate performance is timely, transparent, consistent with our Vision and Core Purpose, and meets the expectations of shareholding Ministers and other key stakeholders.

Context

Landcare Research has a responsibility to provide information that meets the requirements of the Crown Research Institutes Act 1992, the Companies Act 1993, the Financial Reporting Act 1993, the Crown Entities Act 2004, and the New Zealand Institute of Chartered Accountants (NZICA) with regards to New Zealand Generally Accepted Accounting Practice (NZ GAAP).

The following documents will be provided to our shareholding Ministers and MBIE prior to being made publicly available:

- Statement of Corporate Intent (SCI) containing information such as the strategic goals and key performance indicators for the next five years, and summary of the financial performance targets.
- Annual report covering progress against the SCI and progress in the delivery of our National Outcomes. The annual report must be provided within three months of the financial year ended 30 June, i.e. by the 30th September
- Half-year report containing unaudited financial statements, major highlights during the period and indicating progress towards the SCI goals and targets. The half-year report is due by the end of February.

Additional information that is not publicly available:

- Quarterly reports containing unaudited financial statements (including current quarter and year-to-date budgets and full-year forecasts), and significant highlights during the period. The quarterly reports are due by the end of October, January, April and July.

Key Performance Indicator

- Our quarterly, half-yearly and annual reports are delivered on time and meet the expectations of MBIE and the shareholding Ministers

APPENDIX 1

Nationally Significant Databases & Collections

<p><i>Held in Auckland:</i></p> <p>New Zealand Arthropod Collection (NZAC)</p> <ul style="list-style-type: none"> • Largest collection of New Zealand land invertebrates, with many specimens also from the South Pacific; earliest collections date from 1880s • Contains over 1 million pinned specimens, and approximately 6 million stored in ethanol; over 2,500 primary type specimens • Includes the National Nematode Collection of New Zealand (NNCNZ) <p>http://nzac.landcareresearch.co.nz http://fnz.landcareresearch.co.nz www.bugz.org.nz/</p>	<p><i>Held in Auckland:</i></p> <p>New Zealand Fungal & Plant Disease Collection (PDD)</p> <ul style="list-style-type: none"> • Primary source of information on the fungi of New Zealand and of Pacific island countries. • Contains 100,000 dried fungal specimens, including 2,000 type collections • Contains voucher specimens documenting most plant diseases recorded in New Zealand <p>http://nzfungi.landcareresearch.co.nz http://virtualmycota.landcareresearch.co.nz http://fungalguides.landcareresearch.co.nz</p> <p>International Collection of Micro-Organisms from Plants (ICMP)</p> <ul style="list-style-type: none"> • Living cultures of more than 16,000 strains of bacteria and fungi from plants and soil • Mostly stored in liquid nitrogen; others in freeze-dried ampoules <p>www.landcareresearch.co.nz/databases/icmp</p>
<p><i>Held in Lincoln:</i></p> <p>Allan Herbarium (CHR)</p> <ul style="list-style-type: none"> • The largest herbarium in New Zealand is housed at Lincoln; all plant groups are represented, plus lichens • Specialises in plants (native and introduced) of the New Zealand region, and also South Pacific • Specialist collections of seed, fruit, wood, plant leaf cuticle, liquid-preserved specimens, and microscope slides • Over 600,000 specimens with the oldest samples collected during Captain Cook's first voyage to New Zealand, 1769–1770 <p>www.landcareresearch.co.nz/allanherbarium http://nzflora.landcareresearch.co.nz/ www.landcareresearch.co.nz/floras_guides www.nzherbaria.org.nz</p>	<p><i>Held in Lincoln:</i></p> <p>National Vegetation Survey (NVS)</p> <ul style="list-style-type: none"> • A national repository at Lincoln for plot-based vegetation survey data collected throughout New Zealand • A physical archive and computer databank containing records from approx. 77,000 vegetation survey plots including over 19,000 permanent plots, with data spanning more than 50 years. • Broad geographic coverage, with national coverage of data from Northland to Stewart Island, plus the Kermadec and Chatham Islands • Survey data can be deposited with NVS for management and is also available by request <p>http://nvs.landcareresearch.co.nz/</p>
<p><i>Held in Lincoln:</i></p> <p>National New Zealand Flax Collection Living collection at Lincoln of over 160 provenances of <i>Phormium</i> species of cultural, economic and historical interest. It supports research on both traditional and new uses of <i>Phormium</i></p> <p>www.landcareresearch.co.nz/harakeke</p> <p>Ngā Tipu Whakaoranga Ethnobotany database A fully referenced web resource of detailed information on the traditional use by Māori of native plants and fungi, including Māori names for species</p> <p>http://maoriplantuse.landcareresearch.co.nz/</p>	<p><i>Managed through Palmerston North and Lincoln:</i></p> <p>Land Resource Information System (LRIS), including New Zealand Land Resource Inventory (NZLRI) National database depicts general land characteristics (rock, soil, slope, erosion, and vegetation), a derivative general purpose land evaluation (land use capability), and a range of environmental, climatic, management and production attributes</p> <p>http://lrinfo.org.nz</p> <p>National Soils Database (NSD) Physical collection of 1,500 soil profiles from 1,700 different locations throughout New Zealand, with site descriptions and chemical, physical, and mineralogical characterisations.</p>

APPENDIX 2

Formal Collaborative Research Centres, Consortia & Networks

We are part of several national and international initiatives to pool research capability, in areas of our core capability as outlined in the Scope of our Core Purpose.

Ecosystems and ecosystem services, terrestrial vertebrate pest control, biosecurity, integrated social and biophysical research:

- The **Centre for Biodiversity and Biosecurity (CBB)** with the University of Auckland, including the Joint Graduate School www.cbb.org.nz/
- The **Regional Councils' Biodiversity Forum** that decides their priorities for biodiversity research
- The Australian-funded **Invasive Animals Cooperative Research Centre (CRC)**, which is Australia's largest integrated invasive animal research programme www.invasiveanimals.com/
- The **Southern Temperate Ecosystems Research Network (STERN)**, with the Institute of Ecology and Biodiversity in Chile, which is initially focused on invasive species
- The **Global Biodiversity Information Facility (GBIF)**, which collates records from biological collections around the world, and **Species2000 Catalogue of Life**, which is creating a valid checklist of the world's species www.gbif.org/
www.sp2000.org/

Carbon storage and greenhouse gas emissions, climate change adaptation and mitigation:

- The **New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC)** – a partnership of five CRIs, Massey and Lincoln universities, DairyNZ and the Pastoral Greenhouse Gas Research Consortium (PGgRC) www.nzagrc.org.nz/
- The **New Zealand Climate Change Centre (NZCCC)** with Victoria University of Wellington, University of Canterbury, Massey University, and many of the CRIs www.nzclimatechangecentre.org/
- The **Global Research Alliance** on agricultural greenhouse gases brings more than 30 countries together with a focus on research, development and extension of technologies and practices that will help deliver ways to grow more food (and more climate-resilient food systems) without increasing greenhouse gas emissions www.globalresearchalliance.org/

Land cover, land use, and spatial land information; land, soil and fresh water management; integrated social and biophysical research:

- **KiwiImage** – an All of Government project to acquire new higher resolution, multi-purpose satellite imagery for all of New Zealand and its sub Antarctic islands; Land Information New Zealand is now the custodian with Landcare Research a member www.linz.govt.nz/topography/kiwimage
- The **Sustainable Land Use Research Initiative (SLURI)** pools soil science expertise across three CRIs in a programme that develops new tools for regulators and land managers www.sluri.org.nz

Soil characterisation, processes and services; integrated social and biophysical research:

- The **Soil and Land Use (SLU)** research alliance between four CRIs for a more collaborative and integrated approach to research and capability development.
- The **National Land Resource Centre (NLRC;** page 11) provides a gateway to soil and land data, and has responsibility for coordinating capability development across SLU www.nlrc.org.nz
- The **Global Soil Map** is a global consortium to make a new digital soil map of the world using state-of-the-art and emerging technologies for soil mapping and predicting soil properties at fine resolution to assist better decisions in a range of global issues like food production and hunger eradication, climate change, and environmental degradation. We are the Scientific Coordinator of the Oceania Node and lead the Cyber-informatics working group. www.globalsoilmap.net

Industry and business environmental performance, including verification:

- The **New Zealand Life Cycle Management Centre (NZLCMC)** with Massey University and three other CRIs <http://lcm.org.nz/>
- *Urban environments:*
- The **New Zealand Centre for Sustainable Cities** with University of Otago and five other partners <http://sustainablecities.org.nz/>

Antarctica:

- The **New Zealand Antarctic Research Institute**, an initiative led by Antarctic New Zealand to leverage overseas and philanthropic funding <http://nzari.aq/>

APPENDIX 3

Financial Policies

Dividend Policy

Principles adopted for determining annual dividend

In determining the amount of surplus funds, consideration will be given to:

- Shareholder policies on dividends and capital structure
- Providing for strategic and capital investment requirements (including equity investments) without recourse to the Crown for equity injections to the Company
- The Company's working capital requirements (including subsidiaries and businesses in which equity is held)
- Ongoing financial viability of the Company, including its ability to repay debt
- Extent of debt financing in relation to the prudent borrowing capacity of the Company
- Obligations of the Directors under the Companies Act 1993 and other statutory requirements

In a submission to shareholding Ministers, within four months of the end of each financial year, the Board will detail the:

- Amount of dividend (if any) recommended to be distributed to the shareholders
- Percentage of tax paid profits that the dividend represents
- Rationale and analysis used to determine the amount of dividend

Estimate of the amount or proportion of annual tax-paid earnings

An estimate of the amount or proportion of annual tax-paid earnings (from both capital and revenue sources) that is recommended to be distributed to the Crown is provided below, taking into account the statutory requirement to remain financially viable and a going concern, and the following considerations:

- Shareholder policies on dividends and target levels of debt as expressed in the Operating Framework for CRIs
- The Company's peak debt level being within the acceptable range estimated in the Capital Structure Plan (this was independently assessed in May 2006 and reassessed internally in November 2010)
- The Company's three times interest cover covenant, which could be breached with increased borrowing required to fund a dividend
- The range of investment and technology service opportunities available to the Company as set out in its business plan and agreed with shareholding Ministers and the likely requirement to maintain borrowings to fund such projects
- The increased level of capital expenditure required to maintain the Company's science capability and achieve productivity gains through support services
- The Company's projected need for capital to enhance building and IT systems infrastructure
- The Company's projected need for strategic investment to accelerate the creation of national benefit by increasing Landcare Research's science competitiveness and shortening lead times of new knowledge and technologies to market

Shareholder Consent for Significant Transactions

The Board will obtain prior written consent from the shareholding Ministers for any transaction or series of transactions involving full or partial acquisition, disposal or modification of property (buildings, land and capital equipment) and other assets with a value equivalent to or greater than \$10m or 20% of the Company's total assets (prior to the transaction), whichever is the lesser.

The Board will obtain the prior written consent of Shareholding Ministers for any transaction or series of transactions with a value equivalent to or greater than \$5m or 30% of the Company's total assets (prior to the transaction) involving:

- Acquisition, disposal or modification of an interest in a joint venture, partnership, or similar association
- Acquisition or disposal, in full or in part, of shares or interests in a subsidiary, external company or business unit
- Transactions that affect the Company's ownership of a subsidiary or a subsidiary's ownership of another entity
- Other transactions that fall outside the scope of the definition of the Company's core business or that may have a material effect on the Company's science capabilities

Intellectual property transactions, wherever possible in advance, will be notified in the quarterly reports to Shareholding Ministers.

Accounting Policies

The financial statements of the Group are prepared in accordance with the requirements of the Crown Entities Act 2004, which includes the requirement to comply with New Zealand generally accepted accounting practice (NZ GAAP). These financial statements have been prepared in accordance with NZ GAAP. They comply with NZ IFRS, and other applicable financial reporting standards, as appropriate for profit oriented entities.

General Accounting Policies

The measurement and reporting of profit and financial position is based on historical cost.

Particular Accounting Policies

The following particular accounting policies, which materially affect the measurement of profit and financial position, have been consistently applied.

Accounting period

The consolidated financial statements are those of Landcare Research New Zealand Ltd, including its fully owned subsidiaries carboNZero Holdings Ltd and Landcare Research International Ltd, for each financial year ended 30 June.

Statement of cash flows

The terms used in the statement of cash flows are defined as follows:

- (i) Cash means coins and notes, demand deposits and other highly liquid investments in which the Company has invested as part of its day-to-day cash management. Cash includes liabilities which are the negative form of the above, such as the bank overdraft. Cash does not include accounts receivable or payable, or any borrowing subject to a term facility.
- (ii) Investing activities are those activities relating to the acquisition, holding and disposal of fixed assets and of investments. Investments can include securities not falling within the definition of cash.
- (iii) Financing activities are those activities which result in changes in the size and composition of the capital structure of the Company and include the cost of servicing the equity capital.
- (iv) Operating activities include all transactions and other events that are not investing or financing activities. Interest and dividends received and interest paid are included in operating activities.

Revenue

Revenue shown in the Statement of Financial Performance comprises amounts earned by the Company for goods and services supplied to customers in the ordinary course of business.

Income received for goods and services which have not been supplied to customers is recognised as revenue in advance.

Current assets

- (i) Accounts receivable: Accounts receivable are valued at expected net realisable value.
- (ii) Stock: Stocks are valued at the lower of cost on a weighted average price of stock on hand, or net realisable values. In the case of manufactured goods, cost includes direct materials, labour and production overheads.
- (iii) Work in progress: Costs incurred for the supply of goods and services but not billed against customers is recognised as work in progress.

Fixed assets

Completed buildings, plant, motor vehicles, furniture and tools are recorded at cost, less accumulated depreciation. Land and buildings under construction are recorded at cost.

National databases and reference collections

National databases are not valued. Reference collections are valued in accordance with FRS-3, and form part of the 'restricted equity' against which performance targets will not be measured.

Distinction between capital and revenue expenditure

Capital expenditure is defined as all expenditure on the creation of a fixed asset, and any expenditure which results in a significant improvement of the original function of a total asset. Revenue expenditure is defined as expenditure which restores an asset to its original condition and all expenditure incurred on maintaining and operating the Company.

Depreciation

After taking into account likely residual values, all depreciable assets are depreciated on a straight-line basis over their estimated economic lives.

Depreciation rates:

Buildings	1.67–10%
Plant and equipment	4–33%
IT equipment	25%
Motor vehicles	25%
Furniture and fittings	6.67-10%
Office equipment	20%
Library books & periodicals	20–50%
Rare Books collection	1%

Leased assets

The Company leases certain plant & equipment and land & buildings. Finance leases, which transfer to the entity all of the risks and benefits incidental to ownership of the leased item, are capitalised at the present value of the minimum lease payments. The leased assets and corresponding liabilities are disclosed and the leased assets are depreciated over the period the entity is expected to benefit from their use. Operating lease payments, where the lessors effectively retain substantially all the risks and benefits of ownership of the leased item, are included in the determination of the operating profit in equal installments over the lease term.

Research and development costs

Research and development costs are expensed in the period incurred. Development costs are deferred where future benefits are expected to exceed those costs. Deferred development costs are amortised over future periods in relation to expected future revenue.

Intellectual property

No value is ascribed in the Statement of Financial Position to intellectual property assets. Revenue received from the use of intellectual property assets is recognised when earned, and the costs incurred in the maintenance of intellectual property assets are expensed when incurred. Costs incurred in respect of protecting the value of intellectual property (by way of patents) will be capitalised and amortised over future periods in relation to expected future revenue.

Taxation

Taxation is provided in the financial statements on the basis of the estimated taxation payable on the taxable income by each member company of the Group, after taking advantage of all available deductions and concessions. Deferred taxation resulting from timing differences is recognised using the liability method on a comprehensive basis. A deferred tax benefit arising from timing differences is only recognised if there is a virtual certainty of realisation.

Foreign currency translation

Transactions denominated in a foreign currency will be recorded using the exchange rate at the settlement date, except for transactions subject to forward cover contracts, where the forward rates specified in those contracts will be used. Realised and unrealised gains or losses on foreign currency transactions are dealt with in the Statement of Financial Performance. Foreign currency balances are converted at the mid-TT rate applying at balance date.

Financial instruments

Revenue and expenses in relation to all financial instruments are recognised in the Statement of Financial Performance. Financial instruments carried on the Statement of Financial Position include cash and bank balances, investments, receivables, trade creditors and borrowings. These instruments are, generally, carried at their estimated fair value.

Principle of consolidation

The consolidated financial statements include those of the holding company and its subsidiaries accounted for using the line-by-line consolidation method. All intercompany transactions, balances and unrealised profits and losses on transactions between group members have been eliminated.

Changes in accounting policies

Any changes in accounting policies and the effect on retained earnings will be disclosed.

Directory

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General Manager, Science Investment & Evaluation
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Glossary & Jargon Buster

AHB	Animal Health Board; will merge with NAIT (National Identification and Tracing) to become OSPRI New Zealand (Operational Solutions for New Zealand Primary Industries)
BusinessNZ	New Zealand's largest advocacy group for enterprise, and champions policies
Capex	Capital Expenditure
CBD	Convention on Biological Diversity
CEMARS	Certified Emissions Management and Reduction Scheme
CRI	Crown research institute
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
DairyNZ	DairyNZ is the 'industry good' organisation, representing New Zealand's dairy farmers
DOC	Department of Conservation
Ecosystem services	The 'free' services that healthy ecosystems provide e.g. Clean water, fertile soil, storm water retention, erosion prevention
Environmental limits	The point at which ecosystem services collapse, e.g. the soil's biological community is depleted to the extent that they can no longer replenish nutrients
End user	Organisations, entities and people who apply the information and recommendations arising out of our research
FAR	Foundation for Arable Research
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
Kaitiakitanga	Traditional guardianship of natural resources
LCDB	Land Cover Database
LiDAR	Light Detection And Ranging (an optical remote sensing technology)
LINZ	Land Information New Zealand
LRIS	Land Resource Information System
LUDB	Land Use Database
Lysimeter	Device for measuring rate and volume of water filtering down through soil
Mātauranga	Traditional cultural knowledge
MBIE	Ministry of Business, Innovation and Employment (formed from a merger of the Ministry of Science and Innovation with other government departments)
MfE	Ministry for the Environment
MPI	Ministry for Primary Industries (previously Ministry of Agriculture and Forestry, and Ministry of Fisheries)
NeSI	National e-Science Infrastructure
NGO	Non-governmental organisation
NLRC	National Land Resource Centre
NZAGRC	New Zealand Agricultural Greenhouse Gas Research Consortium
NZLRI	New Zealand Land Resource Inventory
NZOR	New Zealand Organism Register
RMA	Resource Management Act
SBC	Sustainable Business Council
SLURI	Sustainable Land Use Research Initiative
S-map	Digital soil map for New Zealand
TB	Tuberculosis
Te Papa	Te Papa Tongarewa, the Museum of New Zealand
UNFCCC	United Nations Framework Convention on Climate Change
ZESPRI	Not an acronym but the name of the kiwifruit marketing authority