LANDCARE RESEARCH
MANAAKI WHENUA

ANNUAL REPORT 2016

Landcare Research New Zealand Limited
(Manaaki Whenua)
Annual Report 2016

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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 of New Zealand, with whom we consult and collaborate.

www.landcareresearch.co.nz

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About Us

Our Organisation

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

Four National Outcomes outlined in this report (pages 19–27) will be achieved through effective science leadership and strong partnerships with our stakeholders who implement research outputs – the knowledge, tools, technology, systems and frameworks, and policy recommendations supporting economic, social, cultural, and environmental well-being.

Our key stakeholders are:

- The Natural Resources Sector: Ministry for the Environment (MfE); Department of Conservation (DOC); Land Information New Zealand (LINZ); Ministry of Business, Innovation and Employment (MBIE); Ministry for Primary Industries (MPI); Te Puni Kōkiri (TPK); and regional councils.
- OSPRI (TBfree New Zealand)
- Māori organisations, iwi, and hapū
- Private sector organisations, including primary industry and businesses implementing sustainable practices

On the Web

More information about the scope of our research, operational activities, governance, and philosophy is available on our web site. Each year we also publish new innovation case studies (referenced in this report) on the web to illustrate how research supported by Core funding is of benefit to New Zealand.

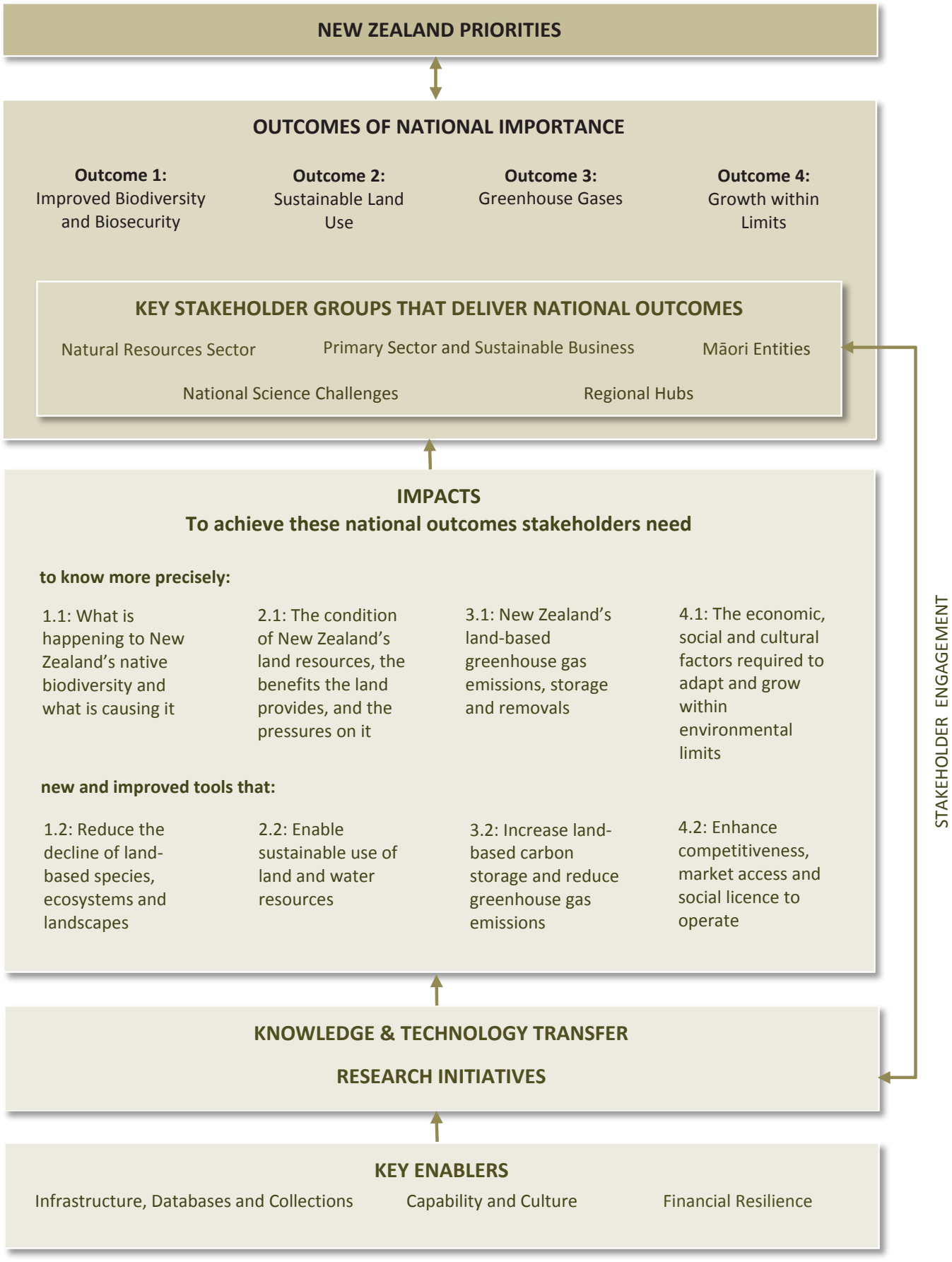
www.landcareresearch.co.nz

National Science Challenges

Landcare Research is the host agency for New Zealand's Biological Heritage National Science Challenge.

www.biologicalheritage.nz

Our National Outcomes & Impacts



Chair & Chief Executive's Review

This has been a remarkable year for Landcare Research and we invite you to enjoy this annual report highlighting our performance and impact. We have seen an extraordinary development of new initiatives across the science sector – both more innovative and more collaborative than we have seen in previous years. We have also seen growing impact achieved by the research, science, and technology done by Landcare Research; and we have continued to forge valued new relationships with stakeholders, especially Regional Councils, Māori organisations, and among the general public in New Zealand.

In this introduction we will provide an overview of progress against the major pillars of the strategy we have been implementing since 2014, which are focused on our people, our partnerships, and the impact we create through our science. Financial resilience underpins our core strategy. Our financial performance in 2015/16 has been robust, notwithstanding the challenges that were common across the science sector and that impacted on our total revenue. We exceeded our return on equity target (6.7% achieved vs 5.0% budget) and our EBIT target ($2.7m achieved vs $2.1m budget).

Our people are Landcare Research, and we acknowledge first and foremost the skills, dedication, and great efforts they bring to their work. As usual, many have been recognised by their peers for the quality of their work. In particular, we recognise Dr Janet Wilmshurst for being elected a fellow of the Royal Society of New Zealand, a well-deserved honour.

This year in particular has been both challenging and rewarding for our staff as they adapted to changes in the organisation and the science sector. Major effort by many staff has gone into winning the contestable research funds that enable us to make our contribution to New Zealand. The Government's 2016 Budget injected welcome, additional science funding into several areas relevant to our work, including nationally significant databases and collections. At the end of the 2015/16 year we were seeing positive signals of success across several contestable funds: MBIE Smart Ideas programmes and Vision Mātauranga, National Science Challenges, and Regional Research Institutes.

The health, safety, and well-being of our people are paramount. As our work involves specific hazards in laboratories and remote locations we depend on the culture, experience, and expertise among our people and the training, processes, and tools we provide. In 2015/16 we commissioned an external review of our policies and practices and we brought staff, leaders, and directors together in a national advisory group to oversee enhancements. We will continue to strive in 2016/17 to provide a sustainable working environment in which our people can give of their best, enjoy their roles, and go home safe each day.

Richard Gordon (Chief Executive) and Jane Taylor (Chair)

Our strategy since 2014 has been to re-position our expertise to ensure our science has impact where it is most needed. Emphasis in New Zealand has grown on issues of freshwater quality and therefore on land use, soils, and natural resource economics; on biodiversity protection and therefore predator control; on sustainable use of Māori land assets and therefore understanding land and biodiversity assets; and on engaging the public in science and therefore making science (and scientists) more accessible. To ensure we are best positioned to support these national interests we have created 15 new science roles and recruited staff who strengthen the capability and culture of Landcare Research.

Our strategy has also focused on enhancing the impact from our work. In essence, our work must be valuable, valued, and adopted by its users for it to have impact in society. Impact comprises a combination of social, economic, cultural, and environmental benefits. To enhance impact we have opened a debate with users and our staff about what makes science valuable and presented our initial findings to an enthusiastic international audience. Aspects seen as critical include co-design of projects and outcomes from the earliest stages, involving the users of our science; allowing head-space in our busy programmes for our staff to innovate and publish; and resourcing

projects to sustain effort beyond the research to include uptake and support of tools and technologies in the market. We will develop this approach further in 2016/17.

Another strategic goal since 2014 has been to build our skills and relationships to support Māori in achieving their aspirations for their land. Māori groups increasingly want to understand their land and natural assets and options for their sustainable use and protection. During 2015/16 we have invested in a new senior Māori leadership role and have developed many new and exciting partnerships and projects. To these we bring our science with humility, acknowledging the world view and deep experience of the natural environment held by our Māori partners. We are especially proud to be working with iwi on the Whanganui River in the Te Awa Tupua project and with Maniapoto and other iwi on options for future land development.

A special development for New Zealand in 2015/16 was government's launch of Environment Aotearoa 2015, the national state of environment report and ongoing initiative to release thematic information (land, water, etc.). This is central to our mission and Landcare Research has been pleased to play a number of roles, including facilitation of an important work stream to identify environmental indicators of relevance to the Māori world, Te Ao Māori.

Landcare Research hosts the New Zealand Biological Heritage National Science Challenge, which is one of eleven new Challenges that are re-shaping science and science-user collaboration in New Zealand. While an initiative of this complexity (17 collaborating parties) and magnitude ($65m of new science funding over 5 years) takes time to organise, we are pleased to note the more innovative and strategic thinking and partnerships that have been developed. The Challenge is promoting the science of new predator-control technologies and ways of engaging with local communities. Both will be central to the new national goal of being Predator Free (possums, rats, and stoats) by 2050. The Challenge is also promoting new ways of engaging communities in achieving biosecurity goals in line with the national Biosecurity 2025 strategy.

Landcare Research is also contributing to other National Science Challenges: Deep South (climate impacts), Resilience to Nature's Challenges (resilience), Sustainable Seas (Māori engagement), Our Land & Water (soils and land research), and Science for Technological Innovation. We are also a founding partner in the Lincoln Hub and delighted to note that 1 July 2016 saw the corporatisation of the Hub. The Hub will play a critical role in achieving additive value over and above the day-to-day, collaborative activities of the partners. Landcare Research has played a prominent role in attracting research investment by overseas multinationals, especially in the area of smart irrigation. The Hub will be central to our strategy of adding value in the primary (agri-business) sector. We look forward to the Hub taking off in 2016/17 under its new and very energetic leadership.

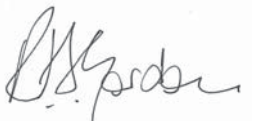
Landcare Research maintains, on behalf of New Zealand, the national collections of plants, invertebrates, fungi, and micro-organisms together with national databases of land, soil, and biological information. Our strategy has been to enable the wider use of the rich value in these assets, including the knowledge of our experts. In 2015/16 we have been successful across a range of projects, from identifying potential biosecurity incursions of national significance, to connecting our national soils data to the OVERSEER tool that is used widely for farm nutrient planning. Behind these examples have been significant developments in data accessibility and biological identification.

During 2015/16 we have seen greater involvement of the public in our work. From our innovative Naturehack 24-hour data-hacking event with Callaghan Innovation, to our nocturnal moth project with the Otago Museum and local schools (and many other projects), the public, and especially youngsters, have shown their deep interest and delight in the treasures of New Zealand nature and what can be done to sustain it for future generations. We are very supportive of the Nation of Curious Minds initiative and are pleased to have led several of its projects that engage the public in 'citizen science'.

A further innovation has been the formation of the Manaaki Whenua Research Trust. We were delighted that the former director and Chair of Landcare Research, Sir Rob Fenwick, accepted the role of Patron of the Trust. The Trust has been set up specifically to provide innovative pathways for members of the public to contribute financially to our vision and to specific areas such as the national collections.

In closing this introduction, we reflect on a very positive year for Landcare Research in 2015/16 and look ahead to 2016/17. We have seen the Environment Aotearoa 2015 report clarify both the opportunities and challenges for New Zealand in managing our natural environment. Landcare Research continues to evolve in order to make the greatest positive impact it can with public resources to meet these opportunities and challenges.

Jane Taylor
Chair



Dr Richard Gordon
Chief Executive

Landcare Research Strategic Focus Milestones

Increasing the value of our science: The scope of our research and the ways in which we engage with our stakeholders are informed from a series of case studies

We have completed a series of case studies with stakeholders and end-users of our research from which we have identified a series of internal and external values for our science. These values have been incorporated into a values framework that is being used to (i) develop leading indicators of the value and likely impact of our research, and (ii) ensure we identify and deliver on all the values relevant to new research we are planning.

Enhancing environmental information: National and regional environmental reporting indicators incorporate our research outputs and datasets

Landcare Research continues to support MfE and Statistics NZ to implement the National Environmental Reporting Act 2015. We made a significant contribution to the development and reporting of national indicators used in the Environment Aotearoa 2015 state of environment report. Most recently, we led work to develop te ao Māori indicators under the Act, and continue to work closely with various regional councils to develop standard methods and indicators in support of national-scale environmental reporting. We provided advice to the Office of the Parliamentary Commissioner on the Commissioner's response to the Environment Aotearoa 2015 report. We are in early-stage discussions with MfE and Statistics NZ about Landcare Research's role in supporting the forthcoming Land Domain report, a key component of the regular suite of environmental reporting now in train under the Act. A number of senior staff provided expert advice to the forthcoming Environmental Performance Review of New Zealand by the OECD, which will include a heavy focus on environmental reporting.

Improving freshwater management: Limit-setting processes under the National Policy Statement on Freshwater Management are informed by our research and models

Landcare Research has played an advisory role in supporting all collaborative limit-setting processes currently in train in New Zealand. We have provided a variety of research to inform limit-setting activities in at least five regions, particularly in the areas of resource economics, soils, sediment/erosion, irrigation potential, microbial contaminants, Māori values, social science, and land-use modelling. One of our senior staff has recently been appointed to a Ministerial Advisory Group on Freshwater Allocation.

Sustainable primary sector growth: Increased number of projects with the primary sector

Two MoUs were signed with primary sector entities to progress collaboration. One Service Level Agreement was signed with a primary sector partner to deliver a large-scale contracted programme. Landcare Research is a Foundation Partner in a Regional Research Institute proposal currently under assessment, which has a strong primary sector focus. We are also involved in three Regional Growth Strategy Action Plan programme areas to support sustainable land use by the primary sector, including Māori agribusiness interests. We continue to develop strategic partnerships and collaborative opportunities with the mānuka honey and natural products sectors, leveraging the biological collections and supporting the growth of international export market value for New Zealand.

Developing Māori land: New partnerships and projects with Māori entities and agri-business

Using marae-based methods, Landcare Research created a science bridge for Māori agribusiness through advice on land-use capability and soils to improve land use and production capability. Post-settlement supplier agreements are now in place to deliver research on flood mitigation, river health, and identification of land-based pressures on waterways. New partnerships were also forged to future-proof mānuka honey production.

BioHeritage Challenge: All seven planned science projects are initiated

Five projects are contracted and underway, and a further two are in the process of contracting, with work to begin early 2016/17 (some preliminary work was done in each project to finalise the project direction before contracting).

Lincoln Hub: MOU (or equivalent) signed with at least two private sector entities for joint R&D activities

We have shown leadership within the Hub to help create two large-scale research opportunities with industry overseas. We expect that contracts will be signed to initiate R&D activities for both opportunities within the first quarter of 2016/17.

Innovation Case Studies

CATCHING A KILLER

Stan Bellgard says innovative science will help catch a pathogen killing kauri forests.

In Western Australia, where Stan Bellgard is from, they call *Phytophthora* a 'biological bulldozer'. Catchy name, isn't it?

And *Phytophthora agathidicida* (or PTA), more widely referred to by New Zealanders as 'kauri dieback', is proving equally destructive. The pathogen has infected New Zealand's kauri forests in the upper North Island, threatening the viability of the iconic taonga tree. Dr Bellgard and his colleagues at Landcare Research share a unique connection to the dieback story: they made the critical discovery that PTA is a new species to science. The killer now had a name and the Landcare Research team had made an important taxonomic discovery. But the push to stop the killer had only just begun. As Dr Bellgard explained, "We clearly needed to find an innovative solution so Landcare Research decided to adopt the holistic Māori world-view and started asking whether there were any beneficial microbes and plants associated with healthy kauri that could be added to the soil to combat the pathogen and aid kauri's inner health."

Landcare Research mycologist Dr Maj Padamsee recently described the fungal partners that live in the short root nodules of kauri. These helper fungi, called *mycorrhizae,* are known to be associated with plant protection against root-pathogens. "We are also looking at other solutions," said Dr Bellgard, "for instance, whether any resistance in the remnant kauri population could provide clues on how to stop it". Phosphite treatments cause diseased trees to produce callous tissue, walling off the infection. And that has given hope that other, additional plant growth promoters, 'super-charged' with pro-biotics, may help too. Mindful that it may take decades to discover a cure for kauri dieback, Dr Bellgard has forged community and cultural partnerships to increase awareness of the risks, and up-take of management interventions.

Each year we add to our website new innovation case studies to illustrate how research supported by Core funding is of benefit to New Zealand. The latest innovation case studies can be found at www.landcareresearch.co.nz/publications/innovation-stories

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DISCOVERING PROSPERITY BY PLANTING DIVERSE PASTURES

Landcare Research scientists have made an important discovery to help the grass grow under farmer's gum boots. Soil scientist Dr Paul Mudge, in collaboration with DairyNZ, discovered the introduction of herbs into ryegrass pastures can increase annual dry matter production by 1.3 tonnes per hectare. The findings, achieved by mixing the likes of chicory and plantain with ryegrass, were discovered during an experiment on DairyNZ's Scott Farm near Hamilton. New Zealand farmers have good ryegrass/clover pasture production models, but currently they don't have any way of modelling more diverse pasture mixes. Dr Mudge's ongoing research aims to use predictive models linking productivity to soil and climate to identify areas in New Zealand that are most likely to benefit from more diverse pastures. The ultimate goal of Landcare Research is to provide information to farmers so they can identify the optimal pasture species and species mixes for specific soil and climate combinations throughout New Zealand. More diverse pastures could reduce dependence on supplementary feed in drier areas, while helping farmers adapt to increased water deficits expected under climate change. There are also potential environmental benefits from integrating more diverse pasture mixes into farm systems: increased carbon sequestration in soil; reduced N leaching and N_2O emissions; improved water use efficiency and resilience to drought stress; and less reliance on fertiliser inputs.

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A CAPE TO CITY CONSERVATION SUCCESS STORY

It's one of the largest wildlife restorations in New Zealand and Cape to City programme leaders are optimistic the Hawke's Bay project will become a template for large-scale renewal of New Zealand's unique biodiversity. Predator control and ecosystem restoration is usually confined to small-scale reserves and sanctuaries. Cape to City encompasses 26 000 hectares of private and public land, most of it productive farmland, between Havelock North and Waimarama Beach, which involves 120 landholders. The programme aims to allow native species to thrive where people live, work, and play, which should see biodiversity, and economic and social gains.

The $6 million jointly funded collaboration has brought together the expertise and know-how of the Aotearoa Foundation, Hawke's Bay Regional Council, the Department of Conservation, and Landcare Research. The project is making an important contribution to New Zealand's Biological Heritage National Science Challenge. An extensive research platform underpins activities, which allows for an evidence-based approach to management, documents the results of work in peer-reviewed literature, and includes training and development opportunities for students.
Hawke's Bay Regional Council (HBRC) biosecurity advisor Rod Dickson said lizard and weta numbers at Poutiri Ao ō Tāne had "gone through the roof" since pest control began. "We've already started to see tomtit and robin turn up at Te Mata Peak (from Cape Sanctuary)."

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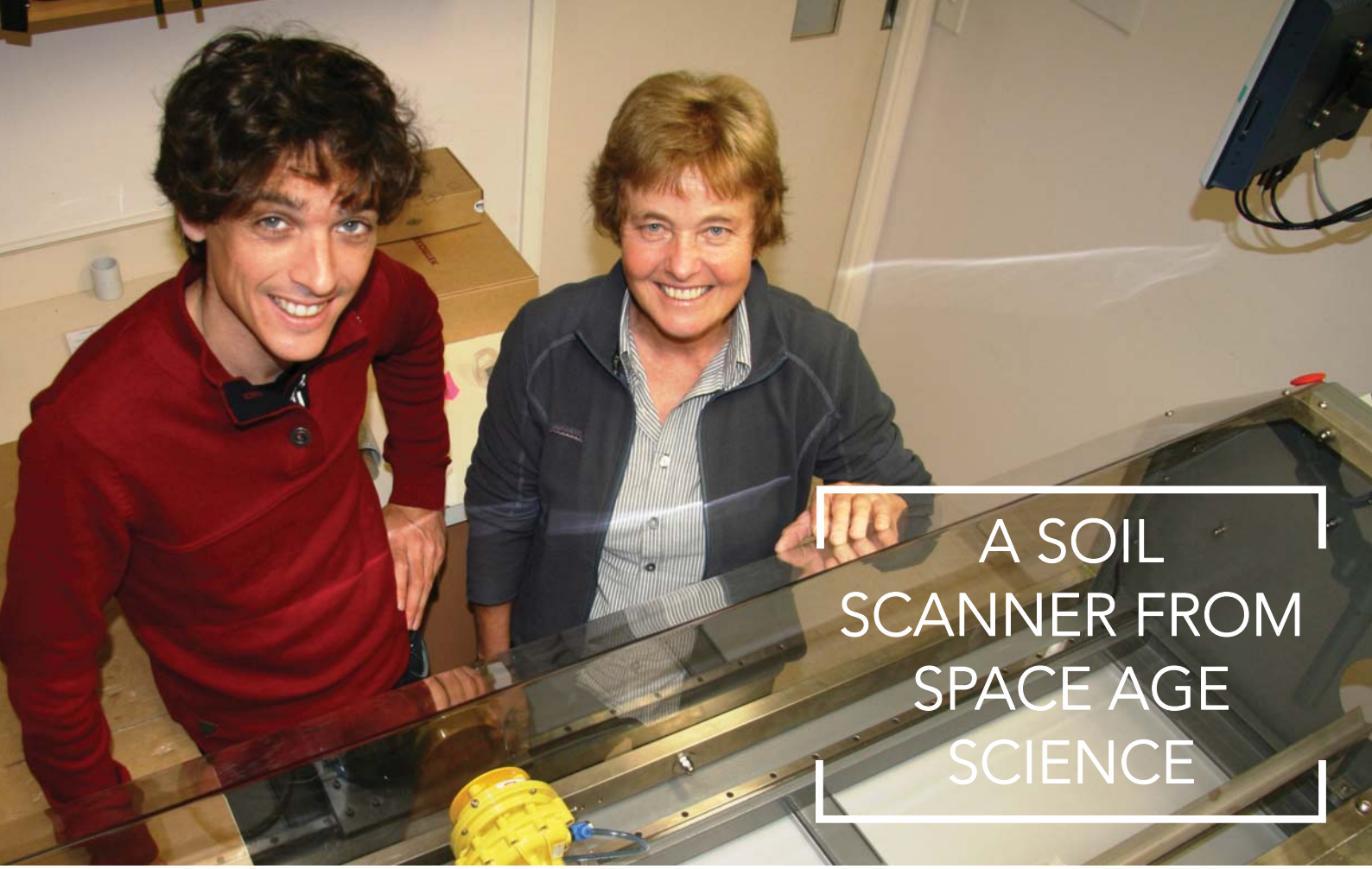

A SOIL SCANNER FROM SPACE AGE SCIENCE

Landcare Research scientists Dr Carolyn Hedley and Dr Pierre Roudier have developed a faster, more efficient soil scanner using space age technology.

Landcare Research is using sensor technologies, similar to those used on the Mars Rover, to rapidly scan soils and estimate soil organic carbon stocks.

Visible near-infrared (Vis-NIR) spectroscopy is being used on a custom-made soil scanner by Landcare Research, as part of a Global Research Alliance (GRA) project. Landcare Research senior scientist Dr Carolyn Hedley said similar technologies are used in space exploration, including Mars Rover, for remote sensing of far-off planets. “The Mars Rover has attached sensors that collect information from the surface of the planet that help scientists infer what minerals Martian rocks contain. Space exploration helped to develop new technology such as soil spectroscopy.”

This research is required because globally we need improved ways of estimating soil carbon stocks so that land owners can be audited and rewarded for any carbon sequestered into soils. Traditional methods of field soil collection are very time-consuming and costly. In contrast, this new sensor ‘survey–scan–predict’ method offers opportunities to drive down the degree of uncertainty associated with estimations of soil organic carbon stocks. Dr Hedley said, “There is two to three times as much carbon in the soil as in the atmosphere. Even a very small increase in soil carbon globally is actually a mitigation strategy for removing carbon dioxide from the atmosphere”.

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HUNGRY HELPERS BEAT WEEDS AND SAVE COUNTRY MILLIONS

Landcare Research researcher Paul Peterson with a handful of heather beetles, another biocontrol agent that's helping New Zealand beat its weed problem.

Waikato dairy and beef farmer Steve Fagan was sceptical to say the least when tiny beetles were released on his farm about 25 years ago to control ragwort.

"When Jim Laurenson, the local biosecurity officer, released flea beetles onto my property, I said he was a fool to do so. I thought it was a big joke." But he would later eat his words. "Ten years on, I went back to shake his hand and say thanks," Steve said. The biocontrol agent was introduced as part of Landcare Research's Beating Weeds Programme. The programme not only introduces biocontrol agents – like the highly successful ragwort flea beetle – but also creates weed distribution databases, models populations of biocontrol agents and weeds and the impact of predation on biocontrol agents, and optimises biodiversity outcomes.

New Zealand has a serious problem with exotic weeds that costs the country more than a billion dollars each year. It is estimated that, unless current weed control is improved, weeds will threaten over 575 000 ha of high priority conservation land within 10–15 years. Taking effective and environmentally safe action against weeds stands to benefit the New Zealand economy by millions of dollars each year as illustrated by a quantitative study, the first of its kind, by Landcare Research, which found the ragwort flea beetle is saving dairy farmers $44 million every year in control costs alone.

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SMART SCIENCE TACKLES LAND USE PROBLEM FOR FARMERS

It's hard for farmers to turn a profit at the best of times, let alone while reducing their nitrogen footprint. But a study by Landcare Research has found farmers can achieve both. Mike and Sharon Barton farm within the vicinity of Lake Taupō. Due to concerns about the health of the lake, the Waikato Regional Council set nitrogen discharge caps on farms to reduce the amount of nitrogen entering the lake by 20 per cent (approximately 170 tonnes). Findings from a 5-year study by Dr Malcolm McLeod, a soil scientist at Landcare Research, found nitrogen leaching from cut and carry lucerne – where the leafy, high protein forage is harvested and baled into hay or silage – is 5 kg per hectare per year, significantly less than the 19 kg per hectare per year set by the Waikato Regional Council and than previous estimates of up to 26 kg per hectare per year.

This gives farmers a lot more leeway as they may only have a discharge allowance of between 12 and 20 kg of nitrogen per hectare per year. Dr McLeod said the findings were great news for farmers. "Costs are going up for farmers and the nitrogen cap limits how much production they can do but lucerne provides a potential alternative. Now they know how much it's leaching, they can put in quite big areas and increase production."

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METHANE-EATING BACTERIA GIVE FARMERS A FILTER FOR THE FUTURE

Two Landcare Research collaborations – one that mitigates methane, the other a more accurate measure of nitrous oxide – may hold the key to New Zealand meetings Greenhouse Gas (GHG) emission reductions. A filter made of soil or other cheaper and more readily available materials (compost, biochar, weathered pine bark) and packed with a very active methanotroph population – bacteria that eat CH_4 - consumed most of the CH_4 delivered to it. Mitigation of CH_4 using biofilter technology could offer the most economical and environmentally friendly way of reducing emissions for an average-sized dairy farm.

Landcare Research scientist Professor Surinder Saggar said, "The world is searching for answers in the post-Paris climate agreement environment and the biofilter, in my opinion, has great potential". Professor Saggar is also heavily involved in research on improving New Zealand agriculture's GHG Inventory, including the possible overestimation of our N_2O emissions. Using New Zealand specific data from a national series of hill country experiments, he has devised a methodology that proves New Zealand's total national agricultural N_2O greenhouse inventory is 18% lower than previously recorded. This includes a 58% reduction in emissions from hill country farms. Based on the current New Zealand Carbon Unit price of $15, these emission reductions correspond to between $25.9 million and $35.4 million in reduced liability for our beef, sheep, and deer sector.

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PLANT COLLECTION IDENTIFIES DANGEROUS MYSTERY WEED

Two of the now dozens of Velvetleaf specimens that Landcare Research has carefully preserved and added to its Allan Herbarium collection.

The Environment Canterbury biosecurity team remember it sitting “on the smoko room table and not having any idea what it was”.

An Amberley farmer found it, a suspicious looking weed, and Lance Smith, an ECan biosecurity officer, decided to send it to the plant identification service at Landcare Research. As manager of Landcare Research’s plant identification service, Ines Schonberger identified Smith’s plant as *Abutilon theophrasti* or Velvetleaf, one of the world’s most invasive pest plants, damaging arable crops by competing with them for nutrients, space and water.

Dr Schonberger has a rather formidable arsenal of tools at her fingertips, including the Allan Herbarium, which holds New Zealand’s largest nationally significant collection of plants. The herbarium is a modern research tool of taxonomic records, some dating back to 1870. Many have been digitised, so anyone with internet access can visit and search the collection at https://scd.landcareresearch.co.nz. Dr Schonberger calls the diagnostic tool a “one-stop shop for any biological endemism in New Zealand” and a way of future-proofing the collection. “Biosecurity officers use the tool to find weeds and specimens and by the end of the financial year there will be close to 3000 images published on it, some dating back to 1870.”

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FUNGI JOIN FIGHT AGAINST INFECTION

Dr Bevan Weir collects another fungi specimen near Glenorchy, Queenstown.

A collection of New Zealand fungi could play a vital role in solving one of the world's most serious health concerns.

Microbes have evolved to become resistant to known drugs, including antibiotics, the importance of which cannot be overstated. A report commissioned by former British Prime Minister David Cameron concluded this resistance could lead to 300 million premature deaths by 2050 and cost the global economy up to £64 trillion. Scientists are therefore searching the world for solutions and here in New Zealand Landcare Research is playing a leading role.

Researchers are methodically trawling through the Crown Research Institute's collection of about 10 000 fungi specimens looking for any medicinal properties that could fight infections. New Zealand scientists have been collecting fungi for a century and Landcare Research is the current custodian of the fruits of their labours. Scientist Bevan Weir believes a solution could be waiting to be discovered in one of the specimens. "What we hope to discover are novel antibiotics with completely new chemistries, new molecules or classes of molecules that have not been discovered before," he said. "It is reasonable to assume fungi in New Zealand might have evolved different antibiotic strategies to kill bacteria from what has previously been seen elsewhere."

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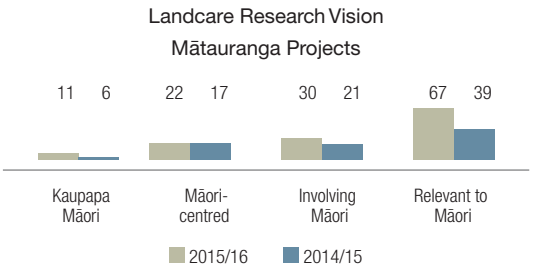
Vision Mātauranga

Senior leaders from Landcare Research paddling down the Whanagnui River (Te Awa Tupua). The team forged a partnership with Ngā Tangata Tiaki to discuss the application of our research to contribute to the healing and restoration of the river and landscape, a place of special spiritual importance for Māori.

Landcare Research's goal is to be the preferred research and innovation partner to Māori to enhance the well-being and value of land-based natural resources.

This year, Landcare Research made good progress towards that goal. In July 2015, we appointed a General Manager Māori Development, who refreshed our Māori sector strategy through engagement with a cross-section of Māori leaders. The strategy, which we will implement between 2016 and 2018, will address priorities for Māori in the areas of land and natural resources research, help Manaaki Whenua be more proactive in engaging Māori stakeholders on potential opportunities for collaboration, and support mātauranga Māori research. Concurrently, we established a new programme to grow internal capability and capacity to deliver on these commitments.

Landcare Research developed a number of new Māori partnerships and programmes in 2015/2016. Some



examples include scoping work for Te Awa Tupua in partnership with Ngā Tangata Tiaki and the Whanganui Awa Settlement Trust; a project on land mapping for Ngāti Porou; and a natural resources project for Ngāti Hineuru. In line with our partnership approach, we have committed to at least two new appointments to support Vision Mātauranga goals, 3 Māori summer internships, and two Māori PhDs annually for the next 3 years to develop the pool of Māori researchers over the medium to long term.

Nationally Significant Databases and Collections: 2015/16

Celebration of the launch of the "Flora of the Cook Islands" by Research Associate W.R (Bill) Sykes on 10 June, 2016.

Landcare Research is committed to ensuring nationally significant databases and collections and associated services are readily available and can be used efficiently and effectively.

PLANT COMMUNITIES

Descriptions of vegetation communities in permanently or temporarily marked plots continue to be in demand and to contribute to international research.

National Vegetation Survey database

http://nvs.landcareresearch.co.nz

10 374 647 records (including tree diameters, sapling counts, species cover scores)

48 875 datasets supplied to 51 users

12 333 web page views (courtesy of Google Analytics)

34 new electronic datasets with 2084 plots added

BIOLOGICAL COLLECTIONS

https://scd.landcareresearch.co.nz

The value of and services provided by the biological collections and databases increased in the 2015/16 period (Characterising Land Biota)

New Zealand Flax Collection (Living Plants)

www.landcareresearch.co.nz/harakeke

18 orders sent (with 100% service delivery)

47 visitors

18 enquiries

The collection was used intensively to support the wahakura programmes (baby bassinets for safe bed sharing) in the Canterbury district.

Ngā Tipu Whakaoranga Ethnobotany Database

http://maoriplantuse.landcareresearch.co.nz

62 087 page views (55 861 last year)

19 400 visitors (16 297 last year)

2408 total number of database records

19 requests for cultural plant information (not flax)

Visitor numbers to the database on Māori plant uses rose over 18% from the previous year.

Allan Herbarium (CHR)

www.landcareresearch.co.nz/allanherbarium

620 000 (approx.) specimens (6494 new accessions)

2310 specimens sent outwards (1280 last year)

52 loan requests responded (100% service delivery)

789 identifications and enquiries (686 last year)

286 number of visitors (240 last year)

The biosecurity content of the electronic Flora of New Zealand and associated databases was extended by digitisation of primary data of the first New Zealand records of naturalised plants. This will enable end-users to easily access plant records of national biosecurity importance.

NZ Fungal and Plant Disease Collection (PDD)

www.landcareresearch.co.nz/resources/collections/pdd

98 810 specimens (1862 new accessions)

25 loan requests responded (100% service delivery)

620 identification and taxa enquiries

525 specimens sent outwards

192 visitors

247 PDD specimens cited in scientific publications (source: Google Scholar)

Data from the NZFungi specimen (PDD and ICMP) and nomenclatural databases were used in a collaborative project with Lincoln University to predict biosecurity threats to NZ with the introduction of new plant hosts.

International Collection of Microorganisms from Plants (ICMP)

www.landcareresearch.co.nz/resources/collections/icmp

20 438 cultures (403 accessions)

133 orders (100% service delivery)

961 cultures (643 last year) provided

254 ICMP cultures cited in scientific publications (Based on Google Scholar)

We released the genome sequences for 62 type and pathotype ICMP strains of *Pseudomonas syringae* (Psa). There are now reference sequences for every gene in every (known) pathovar for MLSA or sequence approaches to identification. This is a nationally important resource for end-users, particularly in biosecurity.

NZ Arthropod Collection (NZAC)

http://nzac.landcareresearch.co.nz

7 million (approx.) specimens

37 loan requests (100% service delivery)

824 identification and taxa enquiries

113 visitors

Biodiversity and Surveys of Poorly Known Regions: A graduate student from the Joint Graduate School (JGS) between Landcare Research and the University of Auckland has recently completed his MSc study of native parasitoid wasps from the Waitakere ranges. He found 136 species, of which only 20% could be assigned a species-level taxonomic name (i.e. 80% were undescribed). This shows the incredible diversity of unknown species that exist in New Zealand, even on the door-step of our largest city.

LAND AND SOILS

Land Resource Information Systems (LRIS)

http://lris.scinfo.org.nz

26 591 visitors

198 305 pageviews

5466 data downloads

4860 users

S-Map Online

http://smap.landcareresearch.co.nz

102 460 pageviews

67 215 application loads

59524 point queries

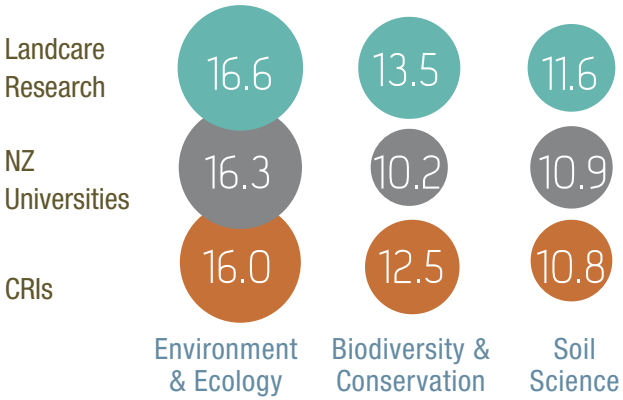
49 959 visits

42 200 soil factsheets generated

2536 maps printed

Knowledge, Technology Transfer & Science Excellence

Average citations per science paper



* average citations/paper (impact) over last 8 years (source: Incites)

Formal agreements

NEW LICENSING AGREEMENTS 8

1 NZ patent granted
2 Joint venture agreements
27 Soil data use licences

Social media

1513 following Landcare Research on Facebook (988 14/15)
1860 following Māori & Polynesian Textile Facebook page (1179 14/15)
1516 members in the Garden Bird Survey group on Facebook
1920 LinkedIn followers

Science team

70 full time science technicians
37 staff sit on 70 stakeholder advisory groups
81 Postgraduate students supervised (56 PhDs, 25 Masters)
13 years (average) of science employee experience (technician 11, support staff 10)

Science excellence

PEER REVIEWED ARTICLES 258

11.4 average citation score for all of our papers published in the last 8 years
60% of peer reviewed articles done in collaboration with international institutes (27% in collaboration with NZ institutes)
286 publications on technical information and research results (including 108 conference papers).
214 technical presentations to user groups

People, Learning & Culture

Health and Safety

41	reported accidents
9	injuries requiring medical attention (10 FY14/15)
2	total days lost to accidents
2.88	medical treatment injuries per 100 staff

Staff age profile

14	staff aged between 20-30 years-old
55	staff aged between 31-40 years-old
103	staff between 41-50 years-old
95	between 51-60 years-old
46	between 61-70 years-old

People profile

54%	of FTEs are male (46% female)
22.4%	work part time hours (3.5% teleworking agreement)
80%	participation in staff engagement survey (with a 63% engagement index rate)
91.5%	staff retention rate (92% in 14/15)
56	research associates

* we support employees with disabilities and hold a register for emergency support purposes.

Ethnicity

58%	NZ
20%	Europe/UK
6%	Australia
5%	Māori
5%	Asian
5%	North America
1%	South America

* Self declared

People, Learning & Culture

Stakeholder engagement

33 university lectures (given by 22 staff)
72 clients on Landcare Research advisory groups
54 new or improved products, processes or services (26 products, 3 processes, 25 services)
8 new MoUs signed in financial year
97 external stakeholders co-located in Landcare Research premises

Environmental sustainability

1527 tonnes of operational CO_2 emissions
5 sets of emissions we measure and offset (flying, energy consumption, fuel use, vehicle travel, refrigerants)
4.1 million kms staff travelled by air and land (last year 5.7 million)
1.6 million kms reduction in staff travel

Our good employer principles

Leadership, accountability, and culture:
We conducted our employee engagement survey and achieved an 80% response rate. Our engagement index is in line with our benchmark to other CRIs. The CEO, senior leadership team, mid-level leaders, as well as new and aspiring leaders, had the opportunity to participate in our leadership development programme. This included workshops, seminars, and coaching opportunities. We have a developed an EEO policy that links to our values and a programme started to increase bi-cultural awareness including Treaty of Waitangi and cultural competency workshops and marae stays and te reo classes.

Recruitment, selection, and induction:
Our robust recruitment and selection policies and procedures ensure we attract high-calibre employees. We are focused on making strategic hiring decisions to ensure we have the appropriate staff capability for the future. Our thorough induction programme ensures new employees settle in safely, quickly, and easily.

Employee development, promotion, and exit:
As part of our performance appraisal and development programme, all staff have opportunities throughout the year to discuss their career, personal development and training, and mentoring with their manager. All individuals have learning and development plans that are actioned and monitored by the Training Co-ordinator. Exit questionnaires are collected and collated from departing employees.

Flexibility and work design:
Landcare Research continues to support flexible working arrangements and provides phones and laptops to improve staff mobility. We offer part-time, variable hours, and teleworking arrangements as appropriate.

Remuneration, recognition, and conditions:
Our remuneration policy is reviewed annually to ensure this supports our recruitment and retention strategies. We benchmark our salary medians against the CRI, science, and general market sectors.

Harassment and bullying prevention:
Our values, together with our Workplace Harassment and Bullying policy, detail our expected behaviours. Landcare Research is committed to maintaining a respectful and safe work environment free from harassment and bullying.

Safe and Healthy environment:
As well as continually improving a mature health and safety management system that has been audited to tertiary level ACC WSMP from 2004 through to February 2016, we are developing integrated health and well-being initiatives with a particular focus on addressing work-related stress and individuals' lifestyle choices.

National Outcomes (Pages 20-27)

1: Improved Biodiversity & Biosecurity

Improve measurement, management and protection of New Zealand's terrestrial biodiversity, including in the conservation estate

2: Sustainable Land Use

Achieve the sustainable use of land resources and their ecosystem services across catchments and sectors

3: Greenhouse Gases

Improved measurement and mitigation of greenhouse gases from the terrestrial biosphere

4: Growth within Limits

Increase the ability of New Zealand industries and organisations to develop within environmental limits and meet market and community requirements

National Outcome 1
Improved Biodiversity & Biosecurity

Improve measurement, management, and protection of New Zealand's terrestrial biodiversity, including in the conservation estate

Background

The integrity of New Zealand's natural heritage is central to our identity, lifestyle, and economy. Intergenerational responsibility for the management of native ecosystems and species, expressed through kaitiakitanga, is also central to Māori aspirations.

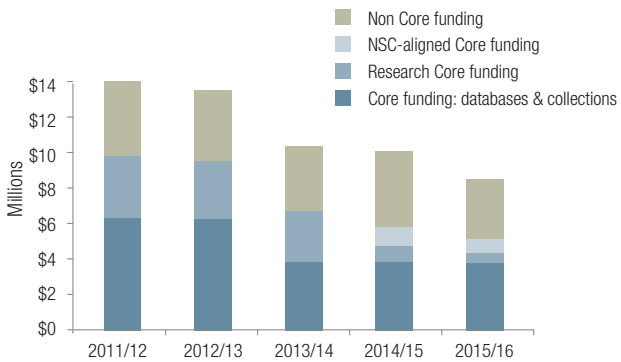
Much of our biodiversity is outside protected areas, and is under increasing threat from invasive species, climate change, agricultural intensification, and land conversion to plantation forestry, mining, and urban development.

We work with DOC, regional councils, wildlife sanctuaries, non-governmental and community groups to deliver this Outcome for New Zealand, as well as contributing through major national initiatives such as the BioHeritage Challenge, Better Border Biosecurity, and Predator Free New Zealand. Increasingly, our work in this area also supports private landowners and the primary sector to take action to conserve biodiversity on private land.

The biologically based Nationally Significant Collections and Databases that Landcare Research hosts on behalf of all New Zealanders are central to this Outcome. They are national science assets that underpin the authoritative identification and description of both native species and invasive pest species, which put these at risk.

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.

Core Funding Investment



Key Performance Indicator 1.1: DOC and regional councils are using comparable metrics to measure status and trend and impacts of interventions on biodiversity within their jurisdictions.

Core-funded progress for 2015/16 is reported in the achievements table, particularly under:

- Enhancing Biodiversity (pages 28–29)
- Characterising Land Biota (pages 35–37)
- Managing Invasives (pages 29–31)

HIGHLIGHTS

New cost-effective kiwi monitoring tools: We have developed a method to obtain kiwi DNA from non-invasive samples (e.g. faeces). We have also developed a marker panel that can discriminate between species and major provenances within species from both good quality invasive samples (e.g. blood) and non-invasive samples. This is the first non-invasive genetic study performed on kiwi and the first study to look thoroughly into the quality and quantity of avian DNA from non-invasive samples.

Genome sequences for Psa released: We released the genome sequences for 62 type and pathotype strains of *Pseudomonas syringae* (Psa). This is a nationally important resource for those working in biosecurity and will, for example, enable development of a diagnostic test for this significant plant disease (e.g. affecting the kiwifruit industry). There are now reference sequences for every gene in every (known) pathovar, and we are now close to knowing the full complement of pathogenic effector genes for these strains.

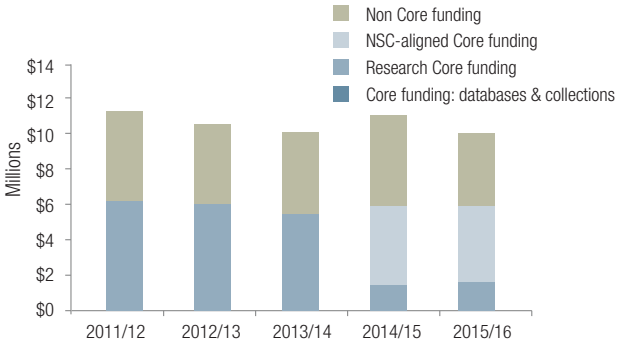
Leadership in Intergovernmental Platform on Biodiversity and Ecosystem Service (IPBES): We developed guidance on including indigenous and local knowledge, and indigenous peoples and local communities, in regional and global assessments led by IPBES. This is an important piece of work in both global research and policy contexts, and showcases Landcare Research's – and New Zealand's – leadership in traditional knowledge research.

New online database of 'true bugs': We completed an online database of true bug (Heteroptera) taxonomic names and deployed these via the New Zealand Arthropod Collection Portal. This searchable online database contains

nomenclatural and bibliographic information associated with native and naturalised New Zealand Heteroptera. The database provides valid or preferred names, main synonyms and biostatus, and links to relevant catalogues and revisions. The true bugs are an important taxonomic group, and we expect this new work will be well used by both biodiversity and biosecurity end-users.

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.

Core Funding Investment



Key Performance Indicator 1.2a: RMA consents related to land-use change are informed by a scientifically-based set of criteria that take account of cumulative effects on habitat availability.

Core-funded progress for 2015/16 is reported in the achievements table, particularly under:

- Enhancing Biodiversity (pages 28–29)

Key Performance Indicator 1.2b: 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.

Core-funded progress for 2015/16 is reported in the achievements table, particularly under:

- Enhancing Biodiversity (pages 28–29)
- Managing Invasives (pages 29–31)

Supporting Business and Policy (pages 34–35)

HIGHLIGHTS

Beetles help wage 'War on Weeds': We released tradescantia tip beetle, tradescantia leaf beetle, and tradescantia stem beetle on the Hikurangi floodplain in Northland to manage the invasive weed, tradescantia, which takes a heavy toll on native species by smothering the ground, preventing regeneration. The Hikurangi floodplain is a 'biodiversity hotspot' characterised by nationally significant forest and wetland. The release of new biocontrol species to manage the impact of tradescantia synergistically highlights the importance of Landcare Research's weed biocontrol work in areas of high conservation status where chemical control is not appropriate.

Rabbit impact on Hawke's Bay pasture: Using grazing exclusion experiments, we measured the effect of low, medium, and high rabbit abundances on pasture growth and estimated the financial cost of rabbit grazing, based on the number of additional ewes that could have been grazed in the absence of rabbits. The estimated net annual benefit of controlling rabbits ranged from NZ$577/ha at low rabbit abundance to NZ$1707/ha at high abundance. Rabbit control is therefore economically justified in Hawke's Bay, even when rabbit abundance is relatively low.

New approach to managing kauri dieback: We have developed a new diagnostic approach for visualising early infection by *Phytophthora agathidicida*, the causative agent of kauri dieback. By using microscopy and fluorescent *in situ* hybridisation (a molecular marking technique used on intact plant material), we can now easily detect the pathogen in kauri just 5 days after infection, facilitating the early-stage detection and management of the disease. MPI and DOC are both very interested in this work and how to take it forward to application.

'Trojan Female' Technique: We demonstrated that reductions in male insect fertility caused by our new genetic-based approach to pest control result in consistent and marked reductions in breeding success. We are following up with laboratory trials to show that these reductions then go on to drive populations down in size. This work will help manage the critical biosecurity threats that insect incursions pose (e.g. the Queensland Fruit Fly, painted apple moth, and other similar recent insect incursions).

Good progress in the Cape to City initiative: Landcare Research is the lead research partner in the Cape to City landscape-scale predator control initiative in Hawke's Bay. The nationally important integrated programme is trialling new approaches to achieve cost-effective, socially acceptable pest control and biodiversity gains at very large scales, including on productive land. To achieve Predator Free New Zealand goals, large-scale predator control needs to be successfully demonstrated.

National Outcome 2
Sustainable Land Use

Achieve the sustainable use of land resources and their ecosystem services across catchments and sectors

Background

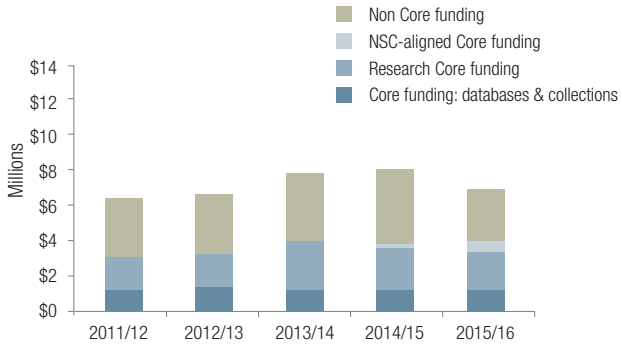
New Zealand's land resources sustain primary sector production, ecosystem services (e.g. clean water, fertile soils), habitat for valued biodiversity, and the aesthetic and intrinsic values on which New Zealand's economy, tourism, and identity are based.

The demand for environmental information to support effective management of land resources in New Zealand is both urgent and growing. Some of our most important natural resources have been over-allocated or have reached critical environmental thresholds as a result of unsustainable land-use practices.

In response, the Natural Resources Sector has prioritised improving national environmental information and initiated a major programme to fill knowledge gaps to enable policy, regulatory and operational agencies, and land owners to manage land within environmental limits.

Impact 2.1: The status and trends of land resources and ecosystem services (including their interactions) are known and understood.

Core Funding Investment



Key Performance Indicator 2.1: Key elements of the Land Resource Information System have been enriched and are being used under the New Zealand Government Open Access Licensing (NZGOAL) framework for web services.

Core-funded progress for 2015/16 is reported in the achievements table, particularly under:

- Characterising Land Resources (pages 31–32)
- Managing Land and Water (pages 32–33)

HIGHLIGHTS

Global leadership of Pacific Soils Partnership: Landcare Research co-led the second Pacific Soils Partnership meeting with government representatives from five Pacific Islands and CSIRO Australia to identify mechanisms to address priority soil issues in the Pacific (nutrient management, soil information security and capacity-building). This work forms part of the United Nations FAO Global Soil Partnership, and is also part of our international leadership in soils research. The meeting resulted in a communique that was tabled to the UN FAO Plenary in May, with the work of Landcare Research and our partner agencies also supporting the development of a business case for $2m investment via ACIAR (Australian Centre for International Agricultural Research) and IFAD (UN International Fund for Agricultural Development). If successful, the regionally focused project will include the development of a Pacific Soils Portal to be hosted by Landcare Research. This is an excellent example of 'science in diplomacy' in action, whereby science helps grow NZ's positive reputation and contribution offshore.

Land-use information to support the Water Reforms: New Zealand does not yet have accurate, up-to-date land-use data. Under contract to MfE, we reviewed land-use mapping methodologies, piloted an assessment of land-use efficiency, and trialled large-scape remote sensing of agricultural land use to help shape the design of a national land-use map/model to better monitor and report the impacts of land-use intensification on environmental quality (particularly for fresh water). This work demonstrates the wide suite of research expertise we can apply to support New Zealand's water reforms.

Supporting Māori economic development: We have been working with a number of Iwi, undertaking land and soil profiles for their rohe. We are working with local economic development strategies 'to' support initiatives which provide more sustainable options for land use, which have led to discussions with local Councils on how our work could support such strategies.

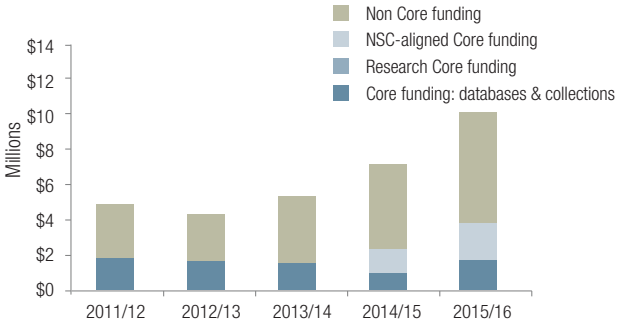
Charting future national soil management requirements: Our National Land Resource Centre has led a suite of translational research across the science system to identify

current pressures on New Zealand soils, soil management practices and readiness to adapt. The resulting three reports – the last of which focused on future requirements for soil management in New Zealand – made a number of recommendations to senior leaders in government and primary industry. These will form the basis of a national Soils Action Plan to be led by MPI.

Benefits of sediment control: After a severe storm in the Manawatū–Wanganui in 2004 caused 62 000 landslides, Horizons Regional Council implemented the Sustainable Land Use Initiative (SLUI), a major soil conservation programme. Our SedNetNZ model was used to evaluate the impact of the SLUI programme in the Manawatū catchment, and results suggest that by 2040, sediment loads will decrease by about 40%, representing an investment with an annual rate of return of 30%. Ongoing application of SedNetNZ with Waikato and Hawke's Bay Regional Councils is assisting them identify and prioritise sub-catchments requiring soil conservation interventions to meet water quality targets.

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.

Core Funding Investment



Key Performance Indicator 2.2: 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.

Core-funded progress for 2015/16 is reported in the achievements table, particularly under:

- Characterising Land Resources (pages 31–32)
- Managing Land and Water (pages 32–33)

HIGHLIGHTS

Launch of interoperable S-map data to OVERSEER®: In mid-May, OVERSEER® version 6.2.2 was released. This version automatically extracts data on soil properties that control nutrient leaching directly from Landcare Research's S-map (national soils) database. This result is the culmination of over 3 years work developing and applying new technologies and approaches in big data and data standards. The new interoperability between OVERSEER® and S-map reduces the manual input of 18 soil data fields by OVERSEER® users, and removes the risk of manual error (or manipulation) by users that results in higher than appropriate nutrient budgets for the property. This is first time OVERSEER® has connected externally to provide auto-population of data, and provides important assurance to support OVERSEER® being used as regulatory tool. The release was widely reported and welcomed in mainstream and social media, highlighting Landcare Research's national leadership in soils and informatics.

Extending the value of the Land Use Capability Classification System (LUCCS): The LUCCS is a key national land information layer used to assess what land can be used for (i.e. its carrying capacity). Improving the utility and relevance of the LUCCS is critical to supporting the water reforms that set nutrient limits, and developing land for productive use. We recently published a National Land Use Capability Extended Legend that correlated, amalgamated, and rationalised LUC units from various regional legends into a single New Zealand-wide set of LUC units, for ready use across the country. Major stakeholders have responded to the new Legend very positively, and support further developments to make available online an interactive Legend with full spatial search capability.

Better nutrient management in the Manawatū: We are partnering with Massey University to deliver a programme of work on land-use mapping, nutrient budgeting, and nutrient attenuation to improve nutrient management in the region. This helps build a strategic relationship with Horizons Council, in support of the Crown's regional growth strategies.

DairyNZ Riparian Planner tool: DairyNZ's Riparian Planner tool went live in March. It was developed by Landcare Research through a commercial contract with DairyNZ and has generated high interest in the primary and government sectors. The tool was profiled in DairyNZ's April 'Inside Dairy' publication and through a seminar to about 40 senior government and primary sector stakeholders. The Riparian Planner tool will help dairy farmers, industry and farm consultants meet Sustainable Dairying Water Accord targets (all dairy farms must have a planting plan in place by 2020, with all Accord waterways planted by 2030). It provides practical support to help landowners meet compliance, and enables sector bodies, councils, and central government to quantitatively assess progress towards targets.

Supporting water reforms: We have been active in leveraging our land resource expertise to support community and council decision-making on limits for water

quality and quantity. As part of this work, we met with a range of groups, including:

- Ruamāhanga Whaitua Committee, to present a general overview of indicators/attributes used to evaluate socio-economic impacts as a result of changes in freshwater management. The Whaitua Committee will agree on attributes to be evaluated and incorporated into a catchment economic model being developed to inform the collaborative process.
- Whangarei Harbour Catchment Group, to present a general overview of the Whangarei Harbour Catchment Modelling Project (a Joint Venture between MPI and Northland Council), and discuss early results on the cost of mitigation to reduce sediment and *E.coli* in the catchment. The Catchment Group will use our work to help inform limit-setting processes.
- Takaka Freshwater and Land Advisory Group (FLAG), Tasman District, to discuss the strengths and limitations of our WaterWheel and water balance modelling projects being used to help the FLAG draw conclusions about appropriate water allocation, environmental flow, security of supply, and water quality limits in the District Plan.

National Outcome 3 Greenhouse Gases

Improved measurement and mitigation of greenhouse gases from the terrestrial biosphere

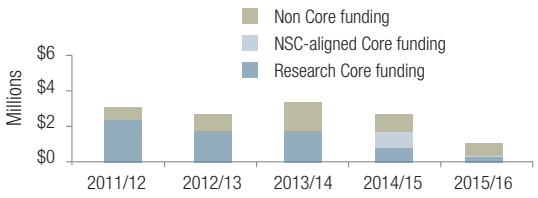
Background

For New Zealand to meet its international greenhouse gas reporting obligations, it is necessary to have a robust inventory of net emissions and carbon storage at a national scale. As the global community, including New Zealand, considers how best to agree and set a new suite of national emissions reduction targets later this year, it will be important for New Zealand to be able to model the environmental and economic impacts of proposed emissions reduction targets, and have access to effective mitigation options for reducing net emissions.

The science challenges are substantial, as are the policy and land management challenges. Collaborative partnerships between research groups, government agencies and the primary industries sector are the key to meeting these challenges and delivering the National Outcome.

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 forecast.

Core Funding Investment



Key Performance Indicator 3.1: MPI and MfE are using verified estimates of greenhouse gas emissions and carbon storage to reduce uncertainty in national inventories.

Core-funded progress for 2015/16 is reported in the achievements table, particularly under:

- Mitigating Greenhouse Gases (pages 33–34)

HIGHLIGHTS

Supporting decisions on New Zealand commitments in Paris: We summarised available information on soil carbon stock changes in New Zealand for MPI. This included an analysis of consequent implications for New Zealand's national greenhouse gas reporting obligations, as well as in terms of meeting any future national greenhouse gas reduction target. Our work was used to inform both governmental consideration of potential risks and opportunities in the lead up to the Paris Climate Conference in December, and New Zealand's negotiating position in respect to emission reduction targets likely to be set at the Conference.

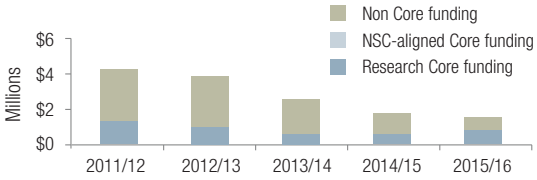
Refining New Zealand's national inventory: Emission factors are key to models that predict greenhouse gas emissions nationally, and so underpin global inventories (e.g. Intergovernmental Panel on Climate Change). We demonstrated large variation in nitrous oxide emissions from fertiliser urea and farm dairy effluent. Urease and nitrification inhibitors produced no consistent reduction in

emissions, showing that the effects of nitrification inhibitors on nitrous oxide emission can vary with the type of nitrogen input, management history, and other site specific factors.

Carbon in old trees vulnerable to climate change: We calculated national-scale carbon stocks and stock changes in New Zealand's natural forests and showed that disturbance is the primary driver of net carbon change, rather than climate or soil fertility. Climate change is forecast to increase both the frequency and intensity of disturbance, presenting a concern for maintaining carbon stocks in natural forests (for example, as part of any new international climate change regime that required national-scale accounting of carbon stocks, similar to the Kyoto Protocol). Our research suggests that old growth forests, where much of the carbon is held in just a few large trees, will be most vulnerable to significant carbon losses under a future of more frequent and intense disturbances.

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.

Core Funding Investment



Key Performance Indicator 3.2: Validated methodologies and land use practices to mitigate greenhouse gas emissions and increase carbon storage and adapt to likely climate change effects.

Core-funded progress for 2015/16 is reported in the achievements table, particularly under:

- Mitigating Greenhouse Gases (pages 33–34)
- Supporting Business and Policy (pages 34–35)
- Managing Land and Water (pages 32–33)

HIGHLIGHTS

Environmental regulation of soil carbon turnover: Using analyses of soil samples from the National Soils Archive collected at different times, we linked multiple environmental factors to the composition of soil organic matter to improve understanding of the make-up and persistence of soil organic carbon in the environment. This work will contribute to recommendations to landowners and industry for greater land-based carbon sequestration.

Better quantifying council emissions: We provided a strategy to the Kapiti Coast District Council for measuring methane and nitrous oxide emissions from composting sewage sludge. This work will help the Council better reduce its greenhouse gas emissions from this source, and also improve reporting as part of its inventory reporting on emissions from waste.

Refining dairy effluent emission factors: We worked with AgResearch to review the most significant variables influencing the greenhouse gas emission factor for farm dairy effluent (FDE) for MPI. We assessed the efficacy of expressing the emission factor for FDE as a percentage of inorganic nitrogen applied and refined New Zealand's country-specific emission factors for urea fertiliser and FDE. This highlighted the need for adequate consideration of soils, climate, and farming systems in country-specific emission factors.

National Outcome 4: Growth within Limits

Increase the ability of New Zealand industries and organisations to develop within environmental limits and meet market and community requirements

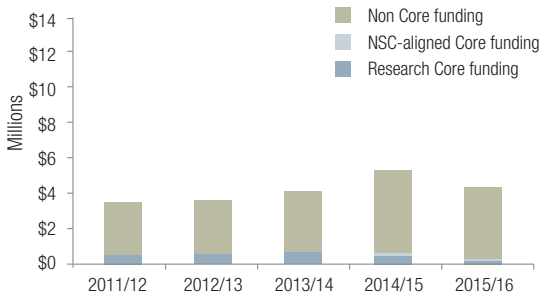
Background

New Zealand's prosperity is heavily dependent on our environment. The prominence in our economy of primary sector production, tourism, and niche sectors reliant on our landscapes (e.g. the film sector) highlight that, long term, New Zealand's economic development can only be sustained by industries and sectors operating within complex environmental limits. This often entails balancing the diverse needs of multiple stakeholders, including government and local government, the private sector, Māori, and the community.

Our research supports agencies tasked with developing and implementing effective environmental policy, regulation, and practices for the sustainable management of land, water, and ecosystem services. Our work also supports MPI and the operational agencies tasked with managing biosecurity issues, and DOC, regional councils, and land managers responsible for weed and pest management. Research aligned to the BioHeritage Challenge will focus on high-tech, next-generation solutions to invasive small mammal surveillance and control. As the Predator Free New Zealand initiative gains profile, there is growing interest in the potentially significant contribution of citizen science projects, particularly at the landscape scale.

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.

Core Funding Investment



Key Performance Indicator 4.1: Industry sectors and 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.

Core-funded progress for 2015/16 is reported in the achievements table, particularly under:

- Supporting Business and Policy (pages 34–35)
- Characterising Land Resources (pages 31–32)
- Managing Land and Water (pages 32–33)

HIGHLIGHTS

Helping shape future environmental policy and regulation in New Zealand: A number of senior Landcare Research staff contributed to the 3rd OECD Environmental Performance Review of New Zealand, providing a range of science-based advice to inform this once-in-a-decade international review. The Ministers for the Environment and Primary Industries also invited Landcare Research's Dr Suzie Greenhalgh onto the Ministerial Advisory Group on Water Allocation to develop options for the allocation of fresh water and discharges in New Zealand. These high-profile examples indicate the influence of Landcare Research staff on the future direction of natural resource management and conservation in New Zealand through provision of expert, authoritative, and independent advice on land and soils, biodiversity and ecosystems, and mātauranga. OECD Review Report recommendations often directly result in change to policy, management, and funding settings. The Ministerial Advisory Group will make recommendations to the incoming (post-election) government for decision late next year. This significant advisory role highlights the influence of our resource economics and policy-centred research on future policy and regulatory regimes in New Zealand.

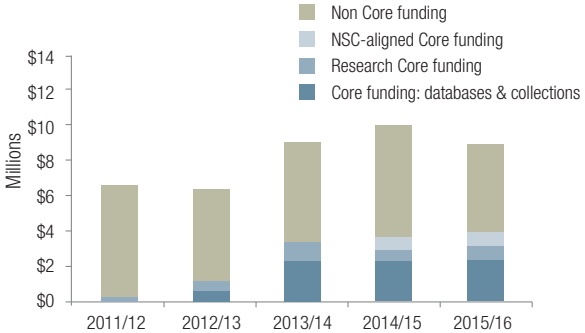
Supporting Crown decisions on water rights: Using our NZFARM model, we analysed for MPI the impacts on iwi of various nutrient allocation options in the Hurunui catchment. The analysis was used to inform policy options being developed by the Crown for fresh water, particularly in respect of iwi. Our analysis clarified the impacts of various allocation options for senior Ministers and iwi leaders, including how the initial allocation of diffuse contaminant discharges can be made in a manner consistent with the Treaty of Waitangi while achieving the greatest economic value from freshwater resources.

Showing it can be done: Catchment-scale actions to improve water quality: We published the results from a major research initiative in the Ruamahanga catchment. A number of our primary sector clients are interested in the findings of our *E. coli* modelling in the Ruamāhanga catchment, which showed that the catchment-wide impact of riparian fencing, dairy effluent ponds, and dung beetles was dramatic, and that synergistic catchment-scale initiatives can deliver major water-quality gains.

Delivering a new approach to modelling pasture water status: We have developed a new way of modelling how pastures respond to water for DairyNZ. Our new approach expresses water availability as water potential, and we have shown that standard ryegrass clover mixtures are much more sensitive to declines in water potential than more diverse mixtures. This means diverse mixtures should require less water under irrigation to maintain production. Our model could be used to optimise allocation of standard and diverse mixtures at the farm or catchment scale to maintain production while minimising water requirements. There is potential for this work to be included in the modelling and decision-making tools provided by DairyNZ to the dairy industry.

Impact 4.2: Best solutions that integrate economic, social, cultural and environmental perspectives to maintain or enhance international competitiveness, market access and social licence for business and industry to operate.

Core Funding Investment



Key Performance Indicator 4.2a: 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.

Core-funded progress for 2015/16 is reported in the achievements table, particularly under:

- Supporting Business and Policy (pages 34–35)
- Characterising Land Resources (pages 31–32)
- Managing Land and Water (pages 32–33)
- Mitigating Greenhouse Gases (pages 33–34)

Key Performance Indicator 4.2b: Bovine TB is eradicated from vector populations in two extensive and difficult forest areas.

On 4 July 2016 OSPRI announced New Zealand had taken another step towards becoming TB-free, with nearly 1.6 million hectares of previously infected land being declared free of the disease since 2011. Core-funded progress for 2015/16 is reported in the achievements table, particularly under:

- Managing Invasives (pages 29–31)

HIGHLIGHTS

Kiwifruit vulnerability assessment: The commercial cultivation of kiwifruit in New Zealand is concentrated in a relatively small area of the North Island. Cultivation is economically significant and growing quickly. We developed a 'bottomup' assessment of vulnerability, with the findings suggesting that climate and markets are the main sources of exposure for growers, with sensitivity moderated by location. Growers employ mostly short-term, reactive adaptive strategies to manage climate exposure and sensitivity, but have less capacity to respond to market-related stressors. This work demonstrates the need to move beyond current vulnerability assessments in New Zealand, to consider a broader range of the factors that contribute to vulnerability in our agricultural sectors. The industry is interested in the findings, and in potential further work on multiple stressors and impacts in the industry. Particularly valuable to the industry are qualitative vulnerability assessments that are spatially specific.

Optimising land use under irrigation: The growth of irrigation schemes enables agricultural intensification and change to more profitable land uses. However, along with economic benefits, irrigation can also lead to adverse environmental effects, such as increased nitrate leaching. Decision makers face the challenge of assessing potential land-use development options and comparing their advantages and disadvantages in the light of socio-economic expectations and environmental limits. This work used our Land Use Management Support System (LUMASS) model to assess land-use development scenarios for two potential irrigation schemes in the Ruamāhanga catchment. There is much industry and Council interest in this work, which essentially spatially optimises land-use configuration in irrigation schemes to maximise economic gain and minimise the environmental footprint.

Economic benefits of ragwort biocontrol: We have published the first economic analysis for a weed biocontrol programme in New Zealand. It demonstrates the scale of the cost saving to NZ dairy farms from ragwort biocontrol (NZ$44 million a year in 2015), and the future gains (NZ$20 million a year) that will arise if the next agent (the plume moth) is successful. It also shows the enormous costs (NZ$8.6 billion in net present value) incurred as a result of rejecting the successful agent, the flea beetle, in the 1930s – costs the NZ dairy sector would have avoided if a small investment in quantitative field trials had been made.

Balancing possum control and surveillance: Optimising the best use of resources for possum control for TB eradication also requires guidance on the most effective balance between using resources for control operations (more costly) versus surveillance (less costly, but does not reduce possum numbers) in any particular context. We produced a modelling framework to underpin such decisions by TBfree Vector Control Managers to guide local disease eradication efforts.

Decrease of 97.5% in herd TB: Recent statistics from OSPRI demonstrate the major benefits of our possum control research for the New Zealand primary sector. Between 1994 and 2014, there was a 97.5% drop in the number of infected cattle and deer herds in New Zealand, primarily driven by wildlife vector control. During this period, Landcare Research was the pre-eminent provider of research to TBfree New Zealand, for both the fundamental design and operationalisation of such vector control.

Core Funding Achievements Table 2015/16

Landcare Research received $24.2 million Core funding in 2015/16 for research to achieve:

Outcome 1: Improved Biodiversity and Biosecurity
Improve measurement, management and protection of New Zealand's terrestrial biodiversity, including in the conservation estate.

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

Outcome 3: Greenhouse Gases
Improve measurement and mitigation of greenhouse gases from the terrestrial biosphere.

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

Our Core funding investment and key 2015/16 achievements are shown in the following table.

Research activity 2015/16 Key Achievements	Core Funding Investment ($M excl GST)	
	2015/16 (planned)	2015/16 (actual)
ENHANCING BIODIVERSITY	**$5.02**	**$5.23**
End-users: DOC; MfE; MPI; MFAT; regional councils; non-governmental conservation organisations (NGOs); community conservation/restoration groups; local government; Environment Court; Fonterra; researchers; Māori; Tūhoe Tuawhenua Trust; consulting firms; community conservation groups; landowners/managers; QEII National Trust; philanthropists; Kiwis for kiwi; Aotearoa Foundation; National Wetland Trust.		
Biodiversity in Production Landscapes – Outcome 1	$0.60	$0.60

- Found that species that evolved for longer in New Zealand are more vulnerable to novel threats than more recent arrivals. This novel, national-scale work on bird occupancy changes across NZ in the 1970s to 2000s was presented at two national conferences (EDS Wild Things and NZES) with widespread public interest. It underlines the urgency required for predator control to save our iconic (deep endemic) species.

- Held a workshop for key representatives of primary industry organisations from which the principal outcome was an agreement to begin to benchmark on-farm biodiversity. The next step is to scope what the benchmarking needs to deliver to meet domestic and international market access demands.

Threatened Species and Ecosystems – Outcome 1 and 4	$1.04	$1.09

- Resolved the long-standing conundrum over the distribution of significant genetic units in kiwi populations in the North Island. It is now clear that some of the historic boundaries applied in kiwi management are not valid, whereas other significant population divisions are clearer. This determines which evolutionarily significant units should share translocation and population management strategies. We also presented our novel kiwi faecal monitoring methods to the Kiwi Recovery Group, captive breeding facilities, community groups, and DOC, supporting kiwi recovery.

- Mapped the genetic patterns of kānuka on the landscape, showing the distribution, high diversity and striking differentiation in some populations north of Auckland. The emerging kānuka oil and honey markets will access this information to inform decisions about production and local provenance. This is one of the most comprehensive landscape genetic studies in New Zealand to date.

- Investigated the fauna of one of New Zealand's rarest ecosystems, namely granite sand plains. The fact that up to five new taxa were identified suggests that some rare taxa do indeed correlate with rare ecosystems.

Research activity 2015/16 Key Achievements	Core Funding Investment ($M excl GST) 2015/16 (planned)	 2015/16 (actual)
Biodiversity Management Outcomes – Outcome 1	$0.72	$0.73

- Attended the translocation of the first 12 kōkako to be returned to Maungatautari Ecological Island in 35 years, after initiating a kōkako recovery strategy in 1988 and many years of preparation. Kōkako is an iconic species returning to Maungatautari, a 3400-ha pest-free mainland sanctuary in the Waikato.

- Demonstrated that mice are deterred by light, supporting earlier anecdotal work. This means that re-invasion by unwanted pest mammals to pest-free areas may be limited with a light-based tool. This may be a significant addition to current tools that protect fenced sanctuaries, jetties on pest-free islands, food warehouses, etc.

- Working with Kiwis for Kiwi and DOC, we derived estimates of growth rates of all ten 'kinds' of kiwi for the first time, and estimated the cost of achieving an average 2% increase of all kiwi taxa by 2030. We found priority taxa for management and research effort are in remote parts of the South Island. We also studied national roles for 'kohanga' (kiwi farms) in kiwi recovery and concluded that while current kohanga should be sustained with some provisos, the best national strategy for kiwi recovery is in-situ population management.

Ecosystems Resilience – Outcome 1	$0.77	$0.79

- Showed that rats prevent ecosystem recovery after fire. Since the arrival of humans, NZ's landscapes have been irrevocably altered by changes in fire regime, invasive plants and animals. We now understand how fire, seed predation, dispersal failure and invasive plants can interact to completely arrest forest succession. Our modelling also suggests that reduction of fire, which is critical to reinstate old forest, requires the control of voracious exotic seed predators such as rats.

- Found a lost ecological link (i.e. pollination) between kākāpō and Dactylanthus (a rare wood rose) through analysis of kākāpō coprolites. With reduced pollination and seed dispersal now major threats to the plant this is important information for its survival. Previously, the only known native pollinator of Dactylanthus was the short-tailed bat.

Māori and Biodiversity – Outcome 1 and 4	$0.33	$0.33

- Used evidence from many disciplines to prove that New Zealand's grey-faced petrel (*Pterodroma macroptera gouldi*), a species of particular importance to Māori, should be regarded as its own species, rather than a subspecies of the great winged petrel (*P. macroptera A.*). This has added another endemic seabird to New Zealand's avifauna.

- Integrated traditional Māori knowledge with fossil-pollen records to create a new framework for restoration. Using information from western palaeocological baselines and mātauranga knowledge systems, we developed bio-cultural restoration goals for coastal ecosystems. This framework is already being picked up by post-settlement entities planning their futures.

- Developed a Te Ao Māori framework for assessing forest health in New Zealand. This framework was co-developed with Tūhoe forest users and elders. Many of the concepts were later generalised into a framework that MfE and Statistics New Zealand will use to report on environmental impacts on Te Ao Māori in national environmental reports.

Measuring Biodiversity Change – Outcome 1 and 4	$1.55	$1.69

- Used the National Vegetation Survey databank and big data techniques to help resolve the question of how many trees the world has. *Nature* published a paper mapping tree density at a global scale, and estimating the number of trees in the world at c. 3 trillion – eight times higher than previous estimates. Trees provide essential services to people, including watershed protection, carbon storage, critical habitat for much of the world's biota and provision of wood, fuel, and food. Knowing how many trees we have and how rapidly we are reducing this resource is critical for our long-term survival and well-being. It was found that humans are responsible for a loss of 15 billion trees per year.

- Collaborated with the Global Earth Observation Biodiversity Observation Network to develop a new approach to invasive species risk prioritisation. The Convention for Biological Diversity (CBD) includes a target to 'identify and prioritise invasive alien species and pathways'. We demonstrated how signatory countries to the CBD can prioritise invasion policy and management by simultaneously focusing on species most likely to invade, the most likely pathways of invasion, and the sites most at risk of invasion.

- Modelled forest dynamics using simple, easy-to-collect data. We co-authored a *Nature* paper that used global data from 3 million trees to show that high growth rate is correlated with easily measured traits. An overwhelming challenge for modelling forests to date has been modelling how each species can affect every other species. The paper demonstrates that we can generalise the outcomes of competition in forests by describing each species in terms of its traits, rather than its species identity.

Research activity 2015/16 Key Achievements	Core Funding Investment ($M excl GST) 2015/16 (planned)	 2015/16 (actual)
MANAGING INVASIVES	**$3.55**	**$3.90**
End-users: MPI; DOC; MFAT; OSPRI; researchers; New Zealand Defence Force; pest control companies; community conservation groups; businesses and industries; regional councils; Invasive Animals CRC; NZ and overseas Universities; AgResearch; ZIP; Island Conservation.		
Beating Weeds – Outcome 1 and 4	$1.28	$1.38

- Performed an ex-post economic analysis of NZ's biological control programme against ragwort and calculated that the ragwort flea beetle (released 1983) is currently saving the dairy sector NZ$44 million/yr in reduced weed control costs. Ragwort biocontrol in NZ began in the 1920s, and a net present value (NPV) analysis gave a 14:1 benefit:cost ratio. In NZ, the flea beetle was rejected as a biocontrol agent in 1933 on anecdotal evidence of its low impact on ragwort. This poor decision cost the dairy industry an estimated NZ$8.6 billion (NPV) from 1945 to 1999: an early investment in scientific trials, rather than relying on anecdotal evidence, would have demonstrated the impact of the flea beetle, and avoided these huge accumulated losses.

- Discovered that the potentially plant-pathogenic bacterium *Candidatus* Liberibacter europaeus (leu) is detectable in broom seed. Furthermore, broom seedlings can develop high levels of leu in the absence of broom psyllids, which were previously thought to be obligate vectors of leu. This raises the possibility that leu was originally introduced into NZ in broom seed, and was not a result of unknowingly importing contaminated broom psyllids for biocontrol in 1983. Testing of broom seed from Europe and New Zealand is needed to shed more light on this question. The transmission of a *Ca.* Liberibacter via contaminated seed raises biosecurity issues for seed exports/imports.

- Successfully gained approval for new biocontrol agents to be released against field horsetail and tutsan.

Reducing Mammal Impacts – Outcome 1 and 4	$1.31	$1.30

- Working with Hawke's Bay Regional Council:
  - demonstrated the benefits of broad-scale mammal pest control for native fauna in farmland (Poutiri Ao ō Tāne)
  - provided an online tool for managers to predict efficacy of various trap configurations and trap check intervals
  - evaluated the importance of community and rural landowner attitudes to implementation of the Cape to City (C2C) initiative
  - determined toxoplasmosis levels in feral cats and sheep
  - produced a map identifying where possum control needs to be concentrated and where it can be delayed in the C2C planning
  - published synthesis of relationships between invasive mammal abundance and impacts on native biodiversity used as a framework for setting control targets in C2C.

- Analysed nationwide data from published and unpublished studies of possum control (either ground-based control or using aerially-delivered baits) to demonstrate for the first time that there are unequivocal quantifiable benefits for indigenous vegetation, birds and invertebrates.

- Predicted the extent of the 2016 mega-mast, using a model relating summer temperatures to post-mast outbreaks of rodents in beech forest. DOC used this for the second stage of the 'Battle for Our Birds' campaign; cost $20.7 million.

- Used the latest climate projections from NIWA to show that there are no clear predicted effects of climate change on the frequency of mega-masts due to high levels of uncertainty in climate projections.

- Demonstrated the value of a new method that can be used by DOC to monitor the impacts of rodents and possums on invertebrate communities in forest canopies; this is based on quantification of insect frass collected in standard seedfall traps.

Mammal Control Tools – Outcome 1 and 4	$0.31	$0.38

- Cemented our partnership with Animal Control Products to commercialise LR's rat-selective compound. Chemistry synthesis has been adapted to produce a flowable powder form that allows easy incorporation into a bait matrix. Testing on Norway rats has been successful. Interest in the compound has grown from international sources (Chevron (AU), Rentokil (UK), ZAPI (IT) and we are in discussions with Indonesia to trial it in palm oil plantations and rice fields.

- Co-funded work on 'chemical camouflage' against mammalian pests, with significant progress identifying chemical constituents of bird odour as predator attractants.

Research activity 2015/16 Key Achievements	Core Funding Investment ($M excl GST) 2015/16 (planned)	 2015/16 (actual)
TB Freedom – Outcome 4	$0.45	$0.47

- Implemented large-scale (up to 80 000 ha) demonstrations of a quicker and cheaper approach to declaring TB freedom in possums.
- Identified how to best allocate funding between TB surveillance and possum control to minimise total expected costs, using decision-theory bio-economic modelling.
- Contributed significantly (through national-scale modelling of alternative strategic scenarios and associated seconded policy advice) to a decision by agricultural industries and government to adopt national eradication as the goal of TB management.
- Worked closely with OSPRI to make our research findings widely available and easily understood through production of 11 web-based factsheets and 8 short articles.

Strategic Developments – Outcomes 1 and 4	$0.20	$0.37

- Developed a new 'proof of freedom' statistical framework to guide the eradication of insect incursions (demonstrated through the case study of Argentine ant eradication from Kawau Island).
- Identified a robust framework for the pre-emptive biological control of arthropod pests.
- Co-funded successful Nation of Curious Minds 'Mould Scene Investigators', working with school children to improve home health.
- Published work indicating that avian malaria is driving frequency changes in immune genes in native New Zealand birds, implying population-scale impacts.

CHARACTERISING LAND RESOURCES	**$3.34**	**$3.55**
End-users: MPI; DOC; MfE; LINZ; PFR; NIWA; regional councils; Statistics New Zealand; DairyNZ; educators; landowners; New Zealand public; data managers; researchers; AgResearch; Māori; Antarctica New Zealand; Antarctic Treaty Countries; primary industries and sector groups (notably the fertiliser industry); Ravensdown; Fonterra; Api NZ; EMaR; OVERSEER®.		
Soil Mapping and Modelling – Outcomes 2	$0.90	$0.64

- Completed mapping of Hawke's Bay, Waikato and inland Canterbury soils using digital soil mapping techniques. Development of a set of soil mapping standards that enable a more consistent approach to soil mapping, particularly at farm-scale, was begun in collaboration with regional councils and industry groups. As soil characteristics are the predominant determinant of leaching of nutrients and other contaminants into waterways, advancing coverage of S-map and ensuring standards for mapping is critical in the development of the next generation of Regional Plans and limit-setting under the National Policy Statement for Freshwater.
- Experienced significant increase in the use of soil information through S-map Online, as evidenced in usage statistics of 1 544 112 map views, 60 432 queries and 40 660 soil factsheet downloads. Access to soil data via OVERSEER® also increased through the development of an interoperable web service that automatically extracts S-map data for soil properties that control nutrient leaching. Version 6.2.2 of OVERSEER® thus reduces the manual input of 18 soil data fields by OVERSEER® users, and removes the risk of manual error or manipulation by users. This is the first time OVERSEER® has connected externally to provide auto-population of data and provides important assurance to support OVERSEER® being used as regulatory tool.

Data Stewardship Infoservices – Outcome 2	$1.63	$1.68

- Launched a new version of the Soils Portal with updated content and functionality for desktop, tablet and mobile platforms. The enhanced site provides access to national mapping datasets such as the NZLRI, FSL, nationally significant databases such as the National Soils Database (NSD), regional soil mapping in S-Map, soil quality indicators and the legacy soil surveys that predate these datasets.
- Further upgraded the National Soils Database Repository (NSDR), including automating the upload of field data from a field collection app. These features contribute to the development of the NSDR into a next-generation system that is capable of efficient upload, storage and interrogation of large quantities of highly variable soil attribute data. The NSDR is crucial for the maintenance of soil observation data, is essential to powering S-map, and has potential to enable environmental reporting initiatives, e.g. Environmental and Monitoring Reporting (EMaR).

Research activity 2015/16 Key Achievements	Core Funding Investment ($M excl GST)	
	2015/16 (planned)	2015/16 (actual)
Ecosystem Services State and Trend – Outcomes 2	$0.81	$0.46

- Used research on the characterisation, scaling and modelling of a range of ecosystem services (ES) to support industry and government in:
    - identifying options for improving ES that benefit farmers and communities (e.g. flood, sediment and nutrient mitigation) in the sensitive Hikurangi Catchment, co-funded through a partnership between Fonterra and the Department of Conservation
    - spatial modelling of floral resources to optimise honey production
    - developing ES-based indicators for incorporation within future iterations of Environment Aotearoa, in collaboration with Ministry for the Environment.

- Application of the ES-based LUMASS tool to determine the impact of agricultural intensification and irrigation potential in Ruamāhanga and the Wairarapa Water Use Project was highlighted in a presentation to Ministers.

Uncertainty and Error – Outcomes 2	N/A *	$0.37

- Developed a statistical error model for the soil water retention curve. This error model, together with a soil profile simulation tool, examination of the impact of soil variability within a farm on OVERSEER estimates of nutrient losses, and an assessment of fitness for use of a simple water balance model contribute collectively to the quantification of uncertainty attributes of the soil information used in policy development.

Land Cover and Land Use – Outcomes 2	N/A	$0.40

- Developed new data processing procedures for Sentinel-2, a new European satellite constellation. Advancements included fully automating the querying of the Sentinel data hub, image assembly and cloud assessment, as well as calibration and correction for atmospheric and terrain effects. Since December >1000 scenes of NZ have been collected (each 100 x 100 km) and will be used to support the generation of future versions of the Land Cover Database (LCDB) and projects reliant on remotely-sensed data to analyse land cover, use and change.

- Improved NZ's ability to produce detailed analysis of paddock-level land use by porting a collection of paddock statistics onto a high-performance computing facility. This development is critical in supporting the increasing volume of images for land-use analysis. Real world farming systems are complex, often with more than one crop per paddock in a single growing season or different practices for the same crop. Analysis of a new region (Hawke's Bay) has allowed us to develop improved approaches to deriving land-use rule sets to support regional planning, policy, and consenting.

MANAGING LAND & WATER	**$3.42**	**$3.43**

End-users: MPI; NIWA; PFR; SCION, ESR; AgResearch; Cawthron; MfE; Consulting firms; researchers; educators; DairyNZ; regional councils; Māori; Waikato-Tainui; Ngati Porou; landfill operators; urban planners; primary industries and sector groups, notably the fertiliser and forestry industries; Agrilink; CropX, Universities.

Fundamental Soil and Plant Processes – Outcome 2	N/A	$1.31

- Established that nitrate concentrations in soils under gorse and broom were significantly higher than under adjacent native vegetation and pasture, and nitrogen leaching from gorse could contribute up to 25% of a catchment's N load if all marginal agricultural land was abandoned and colonised by gorse. Where nitrogen load limits are imposed on catchments, further invasion of gorse and broom on marginal land could limit 'headroom' for agricultural intensification on more productive land.

- Demonstrated the close relationship between C and N cycling under urine patches and that both elements need to be considered when addressing the environmental impacts of grazing-based primary production systems. Little international work is conducted on the impact of urine on carbon cycling or bacterial and fungal community structure and diversity outside of the nitrogen cycle. In a novel project, we showed the response of microbial catabolic function, functional diversity, and bacterial and fungal community structure and diversity to the addition of bovine urine in a range of intensively grazed soils.

- Showed decreases in soil carbon and nitrogen stocks in irrigated, grazed pastoral agriculture and that loss of soil organic matter may have implications for the long-term sustainability of such agriculture in New Zealand. Measurements of microbial community composition and sensitivity of microbial respiration to temperature/moisture were made to identify potential mechanisms for the observed losses.

Research activity 2015/16 Key Achievements	Core Funding Investment ($M excl GST)	
	2015/16 (planned)	2015/16 (actual)
Land Use Intensification – Outcome 2 and 3	N/A	$1.14

- Demonstrated that fungal species ubiquitous in productive system soils can denitrify inorganic nitrogen and produce N_2O even in the presence of oxygen. Showed that significant amounts of N_2O could be produced via abiotic chemo-denitrification in oxic conditions. These results question current understanding of denitrification pathways, open up new avenues for N removal in agricultural soils, and could explain important gaps in N budgets from farm to global scales.
- Established infrastructure to make continuous paddock-scale measurements of carbon, nutrient and water fluxes for irrigated and dryland lucerne on stony soils. These critical measurements help determine management options to enable dairying on leaky stony soils to meet regulations.
- Showed an environmental upside to dairying. In what could be a significant finding, conversion of extensive sheep production to intensive dairying can lead to an immediate increase in soil carbon. This is in contrast to other, longer-term methods that suggest soils under intensive dairying lose carbon.

Soil and Contaminant Management – Outcome 2	N/A	$0.06

- Further assessed the risks associated with soil cadmium to the agricultural sector, focussed on the effects of soil properties on cadmium uptake by agricultural crops.

Erosion Processes and Management – Outcomes 2	N/A	$0.19

- Documented the procedures for setting up and running the SedNetNZ model to ensure its consistent use across NZ. It is used by regional councils as the model of choice for analysing erosion and sediment processes within catchments and the effect of erosion mitigation at catchment scale.
- Developed procedures for assessing the on-site and off-site impacts of erosion mitigation. Quantitative data on the effectiveness of regional council investment in erosion mitigation are scarce but will become important in meeting sediment standards in the National Objectives Framework when they are established.
- Progressed development of an erosion hazard methodology. Used multi-temporal landslide data to quantitatively investigate drivers of shallow landslide erosion. The analysis provides the probability of shallow landslides in relation to drivers and could be used to target erosion mitigation.

Integrated Land and Water Management – Outcomes 2 and 4	N/A	$0.57

- Developed automated soil moisture sensors, including iridium satellite transmission of soil moisture data and an automated method to calibrate and compare commercial sensors for five different soil textures.
- Analysed the effects and effectiveness of plan implementation in developing indicators to support adaptive management and provide socio-economic metrics (e.g. knowledge, attitudes, skills, aspirations, behaviours, etc.), which will assist in improving the efficacy and efficiency of future catchment planning.
- Established experimental lysimeters to assess N leaching under different management regimes.

Toitu Te Whenua – Outcomes 1 and 2	N/A	$0.17

- Compiled a Cultural Wetland Handbook focused on the needs of Māori for the restoration of freshwater wetlands. Case studies are used to identify priority wetlands, demonstrate the use of cultural indicators and monitoring, and outline relevant restoration programmes for future research.
- Demonstrated culturally appropriate approaches to development of Māori lands and showed how agencies can work together in providing Māori land data for NZ Tools and for Māori agribusiness, including for mānuka honey production.

MITIGATING GREENHOUSE GASES	**$1.09**	**$1.12**
End-users: MfE; MPI; AgResearch; SCION, PFR; local body councils; Ngai Tahu; Massey University; LEARN; NZAGRC; GRA; Ballance; researchers; primary industries and sector groups, notably the forestry industry and New Zealand Beef + Lamb.		
Model and Upscale GHG Emissions – Outcome 3	$0.33	$0.33

- Modelled the trade-offs between milk production and soil organic carbon storage in dairy systems under different management

Research activity 2015/16 Key Achievements	Core Funding Investment ($M excl GST) 2015/16 (planned)	 2015/16 (actual)
and environmental factors. Soil organic carbon changes depended on the complex interplay of these factors. Of particular importance was the trade-off between carbon removed in grazing and carbon available for soil organic carbon formation.		
Agricultural GHG Emissions and Mitigation – Outcome 3	$0.51	$0.52

- Demonstrated that adding lime or urine to soils affects the microbial community richness, composition (denitrifier genes), and ability to consume N_2O. Although lime application enhances reduction of N_2O to N_2, it can also increase total N_2O production.
- Developed a simple, farm-scale GHG calculator in collaboration with Beef + Lamb NZ combining the NZ Inventory methodology with recent improvements in hill country emissions. This gained interest from the Pastoral Greenhouse Gas Research Consortium (PGgRc) and MPI for potential application by beef and sheep farmers.
- Established that the methodology developed last year to account for the effects of slope in estimating N_2O emissions from the dung and urine of ruminant animals can be extended to account for slope effects on fertiliser N emissions. This methodology has been recommended for adoption in the NZ Inventory.
- Supplied closed chamber equipment to Kenya Agricultural Research Institute for initiating GHG measurements research with funding from UNDP.

Carbon Storage in Soil and Biomass – Outcome 3	$0.25	$0.28

- Developed a digital soil mapping method to predict soil carbon stocks at farm scale. The method uses high resolution data to disaggregate a national model and guide local sampling. It was implemented at a 460-ha hill country farm and reduced the uncertainty of the national model by up to 69 tC/ha for a mean soil carbon stock value of 94 tC/ha.
- Established a soil spectroscopy research method to remove the effect of soil moisture from Vis-NIR spectra. This enables the use of large soil spectral libraries, derived from air-dry archived soil samples, for predicting soil carbon concentration in field moist soils.
- Assisted the hosting of international delegations from Uruguay and Brazil, sharing research developments in assessing soil carbon stocks using soil spectroscopy and advanced spatial modelling methods.

SUPPORTING BUSINESS AND POLICY	**$0.77**	**$0.73**
End-users: Auckland Council; DOC; Environment Southland; MfE; MPI; Greater Wellington Regional Council; Environmental Defence Society; MBIE; Taranaki Regional Council; SCION; AgResearch; NIWA; Beef+Lamb; HortNZ; StatsNZ; OSPRI; Northland Regional Council; Other Regional Councils; Royal Society of New Zealand; Tasman District Council; researchers; community groups; Māori and other New Zealanders; primary industries and sector groups; businesses; export industries; Natural Resource Sector.		
Biodiversity and Ecosystem Services in Decision-making – Outcomes 1, 2 and 4	N/A	$0.38

- Supported the Business Growth Agenda's new Land Productivity focus and 'Export Double' targets by linking export data through the value chain to specific farm commodities and enterprises. The connections were converted to flow diagrams linking primary sector output to value added goods and trade.
- The LUMASS modelling platform was further developed to better support the modelling and analysis of ecosystem changes and processes and to enable general interoperability with external models and tools, e.g. NZFARM and ARLUNZ. In particular, the following functionality was added to the LUMASS modelling framework:
    - multi-layer combinatorial analysis of large grids (e.g. ecosystem change analysis)
    - generic model component for the integration of external executables into LUMASS models (e.g. NZFARM, ARLUNZ)
    - generic model component for the development of cellular automata (neighbourhood) based models (e.g. pest and weed spread, terrain analysis, hydrological modelling)
- Published in *Policy Quarterly* on how best to preserve NZ's natural heritage, recommending that tax reform is a policy response that begins to integrate fiscal and environmental policy, and a land-use tax could provide a stronger incentive to conserve nature in NZ. At present, the interventions to preserve NZ's natural heritage are not sufficient to halt ongoing loss. This provided the conceptual basis for alternative policy approaches to reduce the environmental impact of land-use decisions. Waikato Regional Council used this research to explore alternative approaches to their rates system.

Research activity 2015/16 Key Achievements	Core Funding Investment ($M excl GST) 2015/16 (planned)	 2015/16 (actual)
Policy, Values and Governance – Outcomes 2,3 and 4	N/A	$0.35

- Identified, using our nationally unique 'Rural Decision-Maker' survey data, the characteristics of rural 'innovators' and 'connectors', and the characteristics of individuals who trust environmental information provided by local government. The findings of this work have been of high interest to various regional councils and NRS agencies such as MPI, MfE, and StatsNZ. Understanding what drives land-use decisions is key to assessing the likely impact of new resource management policies and regulation on both farmer behaviour and the environment. MPI and MfE reported the survey results to their Ministers, and there was very strong interest online from across the primary sector.

- Updated the databases that underpin the Integrated Assessment Model CLiMAT-DGE to reflect the most up-to-date global trade data. This enabled us to improve the modelling of the effects of the 2015 Paris Agreements on New Zealand's economy and GHG emissions, and was used to assess the implication of post-2020 climate policy scenarios. These updates ensure that the modelling capability is available for any additional analysis that may be needed for future climate policy decisions where international trade implications need to be quantified.

- Conducted a choice experiment with land managers and councillors in New Zealand, presenting the first robust evidence of the effect of presenting monetary values to decision-makers faced with a complex, multi-value choice. Our results indicate that monetary values stimulate pro-development choices and, all else being equal, strengthen aversion to environmental degradation. This built new relationships with the University of Wisconsin (US) and University of Waikato.

- Provided a book chapter for a UK publisher on sustainable stormwater management in Auckland, NZ, and included our development of Wynyard Quarter as a case study of an international, award-winning brownfields development. Our research increases knowledge of how people interact with green infrastructure, and is now being disseminated to international and local audiences.

- Analysis of the protection of urban trees in Auckland was used to support hearings evidence in support of stronger protection rules for urban trees in the Auckland Unitary Plan hearings.

- Investigated the efficiency and equity implications of several approaches to allocating nutrient discharges in two NZ watersheds. The analysis informed policy options being developed by the Crown for fresh water, helping senior Ministers and iwi leaders to understand the impacts of various allocation options, including how the initial allocation of diffuse contaminant discharges can be made in a manner consistent with the Treaty of Waitangi while achieving the greatest economic value from freshwater resources. Provided a policy brief to key decision-makers, including the Land and Water Forum.

CHARACTERISING LAND BIOTA	**$6.08**	**$6.22**
End-users: MPI; DOC; MfE; EPA; regional councils; CRIs; Universities; educators; museums; Te Papa; researchers; Better Border Biosecurity (B3); National Science Challenges; Māori and other New Zealanders; primary industries and sector groups, notably the horticultural industry.		
Characterising Plants – Outcomes 1 and 4	$2.42	$2.42

- Progressed discovery, description and interpretation of New Zealand's indigenous and naturalised flora:
    - improved eFlora information content for endusers (DOC, MPI, CRIs, universities) and public (c. 84 000 page views) by adding 2400 diagnostic character images and 10 new moss and fern treatments
    - provided identification guides and described new species of mosses and liverworts, and completed editing for *Flora of New Zealand Liverworts, volume 2*, essential information for DOC, MPI, EPA, MfE, universities, and regional councils
    - identified the algal species *(Lindavia intermedia*) causing lake snot in three large clean water lakes, which has potential to impact significantly on recreational and other uses
    - clarified taxonomic concepts in the diverse and taxonomically difficult genera *Carex* and *Cotoneaster*, which include significant weeds
    - submitted publication on spatial analyses of collection and phylogenetic data to identify hotspots of biodiversity thereby providing new information for conservation prioritisation and reporting for DOC and MfE
    - added 6500 specimens to Allan Herbarium, increased records and data quality in the Specimen Database (9558 records added) and the Plant Names Database (1359 records added), and digitised the first set of the earliest records of naturalised plants (c. 2000 specimens) providing essential information to DOC, MPI, and regional councils
    - identified c. 790 plants in response to queries related to biosecurity and biodiversity, including plants breaching

Research activity 2015/16 Key Achievements	Core Funding Investment ($M excl GST) 2015/16 (planned)	 2015/16 (actual)

border biosecurity, an essential service for DOC, MPI, and regional councils

- progressed enhancement and use of National NZ Flax and other living collections, and the further development of the infobase Ngā Tipu Whakaoranga on cultural uses of plants. There were 19 000 visits to infobase, with over 25 000 sessions.

Characterising Invertebrates – Outcomes 1 and 4	$1.70	$1.75

- Progressed discovery, description and interpretation of NZ's indigenous and naturalised terrestrial invertebrate fauna for utilisation by NZ biosecurity and biodiversity end users:
  - improved online information content by 15,000 new records and enhanced the web portal for NZ Land Invertebrates with new names, images and specimens
  - supported MPI biosecurity responses by co-funding two training courses for MPI staff on diagnostics of beetles and moths and undertaking taxonomic studies on *Meloidigyne* nematodes, which are currently the target of a biosecurity response
  - collaborating with MPI, we published a taxonomic revision of the mite genus *Pneumolaelaps*, which is a potential wasp biocontrol agent. The revision includes critical descriptions of new mite species associated with introduced wasps, basic biological information, and a diagnostic key for NZ species
  - published checklists and catalogues of the hyperdiverse beetle groups Aleocharinae and Carabidae, providing stakeholders with up-to-date names. These beetle groups include many species of major biodiversity, ecological and biosecurity significance
  - described two new genera of true bug (Saldidae) with accompanying information on diagnostics, geographic distribution and biology of species. These species are excellent indicators of riparian ecological health
  - published new species and diagnostic tools for oribatid mites, important components of many native ecosystems.

Characterising Fungi and Bacteria – Outcomes 1 and 4	$1.37	$1.39

- Progressed discovery, description and interpretation of New Zealand's fungi and bacteria:
  - more than 80 *Trichoderma* cultures accessioned into the International Collection of Microorganisms from Plants providing an important resource for biosecurity management of these fungi, used extensively in the biological control of fungal pathogens
  - training courses on fungi and on the fungal pathogen *Colletotrichum* were conducted in Auckland, Brisbane, and Freemantle. The participants from biodiversity and biosecurity agencies will be better able to incorporate fungal impacts into their management plans
  - DNA sequencing showed a *Sophora* powdery mildew is exotic rather than indigenous as previously believed; this is important for biosecurity management and the wine industry
  - new species of fungal pathogens were described from *Tradescantia fluminensis* in a biological control survey; two have potential as new biocontrol controls for this weed
  - our survey of mycorrhizal fungi associated with the roots of kauri provides a better understanding of the drivers of kauri dieback, contributing to minimising the disease and its impact
  - we released genome sequences for 62 type strains of the plant pathogenic bacterium *Pseudomonas syringae*. This resource will enable biosecurity managers (e.g. MPI) to develop more rapid and accurate diagnostic tests for these pathogens
  - analysis of NZ Fungi data quantified host switches between exotic and indigenous pathogens and their exotic and indigenous hosts, providing the framework to allow new approaches to assessing biosecurity risk of newly introduced fungi
  - NZ endemic fungi were added to the IUCN Red List, providing a robust framework to allow DOC to manage threatened fungi in New Zealand.

Collections – Information, Access and Value -- Outcomes 1 and 4	$0.59	$0.66

- Progressed pan-organisation research initiatives:
  - contributed to Better Border Biosecurity (B3) through agreed nematode research towards better border biosecurity
  - engaged with the formal Landcare Research Characterising Land Biota Advisory Group and implemented agreed stakeholder priorities to underpin biosecurity and biodiversity management
  - correctly annotated DNA sequences from our Collection specimens in the global DNA database GenBank, thus delivering higher confidence that the sequence is correct for biosecurity managers
  - enhanced and released new versions of data management tools for specimen data and for taxonomic names

Research activity 2015/16 Key Achievements	Core Funding Investment ($M excl GST) 2015/16 (planned)	 2015/16 (actual)

- completed the initial implementation phase of the Annotation Tool that is used to manage the descriptive content in eBiota and Maori Plant Use Infobases
- completed the design for a new responsive design for the eBiota website to facilitate mobile use
- started a PhD on automated georeferencing of locality strings (Supervisor: Kristin Stock, Massey University), to increase accessibility of specimen data for spatial analysis and presentation
- through a lens of international best practice, wrote an implementation plan for international review recommendations on managing the Collections, databases and information infrastructure, research direction, end-user engagement, commercialisation and revenue generation.

* Figure not comparable to previous year.

Non-Financial Performance Summary

	Indicator as per the SCI 2015–20	2015/16 Actual
Stakeholder engagement	Percentage of relevant end-users who have adopted knowledge and/or technology from Landcare Research (data provided from MBIE's biennial external client survey)	93%
	Percentage of relevant funding partners and other end-users who have a high level of confidence in Landcare Research's ability to set research priorities (data provided from MBIE's biennial external client survey)	67%
	Revenue per FTE ($000)	$178
	Revenue per FTE from commercial sources ($000)	$53.27
	Commercial reports per science FTE	0.9
Vision Mātauranga	Number of positive strategic partnerships with iwi and Māori organisations in which we are linking science and mātauranga and which address Māori gaols and aspirations	63 (the figure collates the Kaupapa Māori, Māori-centred and Involving Māori and VMM indicators)
Science excellence & collaboration	Publications with collaborators	Other NZ: 27% Overseas: 28% Both NZ & Int'l: 32% Joint papers total: 88%
	Impact of scientific publications (mean annual SCImago ranking for the journals in which we published).	3
	Percentage of relevant national and international research providers that have a high level of confidence in Landcare Research's ability to put together the most appropriate research teams (data provided from MBIE's biennial external client survey).	84%
Use of Databases & Collections	Availability of data from Landcare Research's MBIE Strategic Funded databases, collections and information systems (assessed by a variety of metrics appropriate to each)	(see Databases and Collections chapter)
	Specimen transactions, identification requests and visitors to our MBIE Strategic Funded biological collections and associated infrastructure. Revised last year to focus on service delivery.	100% service delivery (see Databases and Collections chapter)
Technology Transfer	Number of new and existing licensing deals of Landcare Research-derived IP (including technologies, products and services) with New Zealand and international partners	8
People, Learning & Culture	Staff engagement in survey evaluations	63% engagement index rate (80% participation in survey)
	Staff retention rate	92%

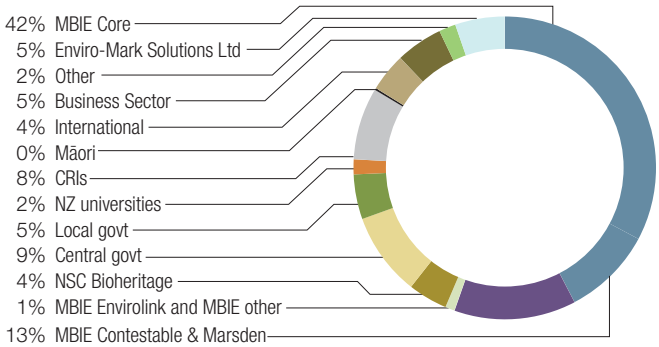
Financial Performance Summary

Summary table of group financial performance

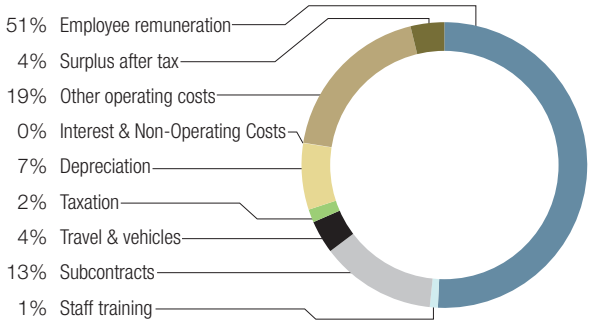
	2014	2015	2016	2016	2017
	Achieved	Achieved	Target	Achieved	Target
Revenue, $m	54.7	58.2	59.2	56.9	61.9
EBIT before investment, $m	3.6	3.0	3.0	3.4	2.0
EBIT, $m	2.9	2.2	2.1	2.8	1.3
Investment, $m	0.8	0.8	0.8	0.6	0.8
Total assets, $m	45.4	47.7	50.0	53.6	53.8
Return on equity	7.2%	5.5%	5.0%	6.7%	2.8%
Dividend $m	-	-	-	-	-
Equity ratio	63%	66%	66%	64%	62%
Gearing	0%	0%	0%	0%	0%
Interest cover	658	N/A	614	336	34

NB: Revenue excludes income from interest on investments and from finance leases, $0.3m for 2016 (2015: $0.2m)

Revenue by source (2015/16)

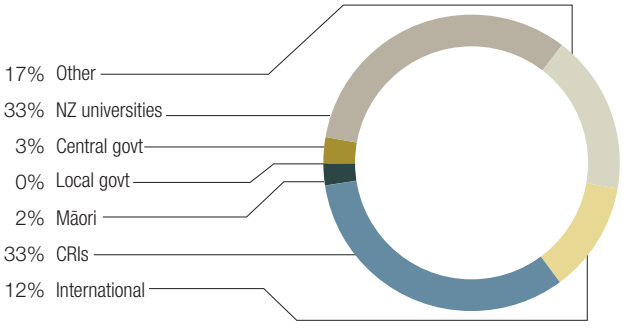


Where our revenue goes (2015/16)



Subcontracts to research partners by sector

Total = $7.48m in 2015/16 ($6.98m in 2014/15)



Report of the Directors

Directors (back row, L-R) Gavan Herlihy, Caroline Saunders, Steve Saunders, Chris Downs, (front row) Paul Reynolds, Jane Taylor (chair), Victoria Taylor and Emily Parker.

For the year ended 30 June 2016
The Directors of Landcare Research New Zealand Limited are pleased to report that the Company fulfilled its obligations under the Crown Research Institutes Act 1992 for the year ended 30 June 2016. The disclosures relate to Landcare Research New Zealand Limited and its subsidiaries (the 'Group').

The Company is a private company limited by shares and incorporated in accordance with the Companies Act 1993.

Principal activity
Landcare Research's principal activity is to provide scientific research that fulfils our Core Purpose in accordance with the Crown Research Institutes Act 1992.

Operating results
Group revenue for the year reduced to $57.2 million from $58.4 million in the previous year. The consolidated net surplus before taxation expense for 2015/16 was $3.1 million and the consolidated net surplus after tax attributable to Parent Company shareholders was $2.2 million. Return on equity was 6.7%, compared with the target of 5.0%.

Remuneration of Directors
Directors fees are set by the shareholding Ministers annually.

	2015/16 $	2014/15 $
Jane Taylor	46,000	28,750
Chris Downs	23,000	23,000
Gavan Herlihy	23,000	23,000
Emily Parker*	39,000	37,666
Paul Reynolds	28,750	-
Caroline Saunders	23,000	-
Steve Saunders	23,000	23,000
Victoria Taylor*	47,000	47,000

* These include fees for Victoria Taylor as Chair of the subsidiary EMS and Emily Parker as the Landcare Research observer on the BioHeritage National Science Challenge.

Changes to Board composition
Caroline Saunders and Paul Reynolds (Deputy Chairman) were appointed on 1 July 2015.
Victoria Taylor retired from the Board on 30 June 2016.

Subsidiaries
The Directors of the two subsidiary companies are:

Enviro-Mark Solutions Limited
Victoria Taylor (retired 30 June 2016)
Paul H S Reynolds (appointed 1 July 2016)
Richard F S Gordon
Nigel W Thomson

Landcare Research US Limited
Phil B S Hart
Nigel W Thomson

Directors' insurance
The Company has Directors' and Officers' insurance cover in respect of any act or omission in their capacity as a Director of the company. The Company has indemnified Directors and certain employees of the Company for costs and proceedings and for liabilities incurred by the employee in respect of any act or omission in his or her capacity as an employee of the Company. The indemnity for liabilities incurred does not extend to criminal liability or liability for breach of a fiduciary duty owed to the Company.

Dividends
No dividends have been declared or paid in respect of the 2016 financial year.

Directors' interests
Any business the Group has transacted with organisations in which a Director has an association has been carried out on a commercial 'arms-length' basis.

Compliance
The Directors confirm that the Company has operated in accordance with the Crown Research Institutes Act 1992 and the Companies Act 1993 during the year. The activities undertaken by the Company in the year are in accordance with the Landcare Research Statement of Core Purpose. No written direction was received from either shareholding Minister in the year.

No directors acquired or disposed of equity securities in the company during the year; and the Board has received no notices from directors of the company requesting to use company information received in their capacity as directors that would not otherwise have been available to them.

Donations
The Group has made various donations totalling $0 during the year ($1k in 2014/15).

Auditors
John Mackey of Audit New Zealand has been appointed as the audit service provider by the Auditor-General.

The Auditor-General is the statutory auditor pursuant to section 14 of the Public Audit Act 2001 and section 21 of the Crown Research Institutes Act 1992. Their audit remuneration and fees are detailed in note 3 of the 'Note to the financial statements'.

Events subsequent to balance date
The Directors are not aware of any matter or circumstance since the end of the financial year not otherwise dealt with in this report that has, or may have, a significant effect on the operation of the Company.

Employee remuneration
The number of employees and former employees who received remuneration and other benefits totalling $100,000 or more, in $10,000 bands, during the year were:

	Number of Employees	
Total Cost to the Group	2015/16	2014/15
$440,000 - $449,999	1*	1*
$420,000 - $429,999		
$230,000 - $239,999	1	1
$220,000 - $229,999	2	3
$210,000 - $219,999		
$200,000 - $209,999	4	3
$190,000 - $199,999		
$180,000 - $189,999	1	2
$170,000 - $179,999		
$160,000 - $169,999	2	3
$150,000 - $159,999		3
$140,000 - $149,999	7	5
$130,000 - $139,999	7	7
$120,000 - $129,999	7	12
$110,000 - $119,999	15	19
$100,000 - $109,999	24	26

* Chief Executive of Landcare Research New Zealand Limited.

This table includes one redundancy and termination payment to employees in 2015/16 (2014/15: nil)

Signed for and on behalf of the Board

Jane Taylor
Chair
24 August 2016

Paul Reynolds
Deputy Chair
24 August 2016

Audited Financial Statements

of Landcare Research New Zealand Limited

Statement of comprehensive income

for the year ended 30 June 2016

	Note	Group 2016 Actual $000s	Group 2016 Budget $000s	Group 2015 Actual $000s
Revenue	2.	57,157	59,309	58,426
Finance costs	3.	21	10	0
Operating expenses	3.	54,085	57,055	56,012
Profit / (Loss) before tax		**3,051**	**2,244**	**2,414**
Income tax expense	24.	864	628	740
Profit after tax		**2,187**	**1,616**	**1,674**
Total comprehensive income		**2,187**	**1,616**	**1,674**

The accompanying notes form part of these financial statements.

Statement of changes in equity

for the year ended 30 June 2016

	Group 2016 Actual $000s	Group 2016 Budget $000s	Group 2015 Actual $000s
Balance at 1 July	**31,532**	**31,389**	**29,858**
Total comprehensive income for the year ended 30 June	2,187	1,616	1,674
Balance at 30 June	**33,719**	**33,005**	**31,532**
Total comprehensive income attributable to:			
Parent company	2,187	1,616	1,674
	2,187	**1,616**	**1,674**

The accompanying notes form part of these financial statements.

Statement of financial position

as at 30 June 2016

	Note	Group 2016 Actual $000s	2016 Budget $000s	2015 Actual $000s
ASSETS				
Current assets				
Cash and cash equivalents	4.	8,982	6,215	5,595
Trade and other receivables	5.	6,818	8,719	8,669
Inventories	6.	15	50	16
Short Term Deposits	4.	6,049	0	0
Finance lease receivable	7.	34	34	94
Derivative financial instruments	8.	0	0	40
Total current assets		**21,898**	**15,018**	**14,414**
Non-current assets				
Property, plant and equipment	9.	30,241	32,803	31,469
Patents and intellectual property	10.	539	560	544
Intangible assets	11.	451	1,066	718
Finance lease receivable	7.	474	474	508
Total non-current assets		**31,705**	**34,903**	**33,239**
Total assets		**53,603**	**49,921**	**47,653**
LIABILITIES				
Current liabilities				
Trade and other payables	13.	5,868	6,385	6,062
Employee benefit liabilities	14.	4,068	4,103	4,214
Revenue in advance	15.	5,916	2,381	1,617
Tax payable		739	209	549
Derivative financial instruments	8.	12	0	0
Total current liabilities		**16,603**	**13,078**	**12,442**
Non-current liabilities				
Employee benefit liabilities	14.	682	571	694
Deferred tax liability	24.	2,599	3,267	2,985
Total non-current liabilities		**3,281**	**3,838**	**3,679**
Total liabilities		**19,884**	**16,916**	**16,121**
NET ASSETS		**33,719**	**33,005**	**31,532**
EQUITY				
Ordinary shares	16.	10,515	10,515	10,515
Retained earnings	16.	23,204	22,490	21,017
Total equity		**33,719**	**33,005**	**31,532**

The accompanying notes form part of these financial statements.

Jane Taylor
Chair
24 August 2016

Paul Reynolds
Deputy Chair
24 August 2016

Statement of cash flows

for the year ended 30 June 2016

	Note	Group 2016 Actual $000s	2016 Budget $000s	2015 Actual $000s
Cash flows from operating activities				
Receipts from customers		63,194	58,925	57,672
Interest received		145	120	95
Payments to suppliers and employees		(49,830)	(52,693)	(50,864)
Interest paid		(21)	(10)	0
Tax refund/(paid)		(1,060)	(533)	(1,030)
Net cash generated from operating activities	18.	**12,428**	**5,809**	**5,873**
Cash flows from investing activities				
Purchase of short term investments		(6,049)	0	0
Proceeds from sale of property, plant and equipment		1	0	1
Purchase of property, plant and equipment		(2,870)	(5,146)	(2,224)
Purchase of intangible asset		(123)	(355)	(143)
Net cash used in investing activities		**(9,041)**	**(5,501)**	**(2,366)**
Cash flows from financing activities				
Drawdown (repayment) of borrowings		0	0	0
Net cash generated from (used in) financing activities		**0**	**0**	**0**
Net increase/(decrease) in cash		**3,387**	**308**	**3,507**
Cash, cash equivalents and bank overdrafts at beginning of the year		5,595	5,907	2,088
Cash, cash equivalents and bank overdrafts at end of the year		**8,982**	**6,215**	**5,595**

The accompanying notes form part of these financial statements.

Notes to the financial statements

for the year ended 30 June 2016

1. Summary of Accounting Policies

Reporting entity

Landcare Research New Zealand Limited is a Crown Research Institute governed by the Crown Research Institutes Act 1992, Crown Entities Act 2004, Companies Act 1993 and the Public Finance Act 1989. The Landcare Research Group ('the Group') consists of Landcare Research New Zealand Limited and its subsidiaries, Landcare Research US Limited (100% owned) and Enviro-Mark Solutions Limited (100% owned). Landcare Research New Zealand Limited and Enviro-Mark Solutions Limited are incorporated and domiciled in New Zealand; Landcare Research US Limited is incorporated and domiciled in the USA.

The core purpose of the Group is to drive innovation in New Zealand's management of terrestrial biodiversity and land resources in order both to protect and enhance the terrestrial environment and grow New Zealand's prosperity.

These audited financial statements of the Group are for the year ended 30 June 2016 and were authorised by the Board of Landcare Research New Zealand Limited on 24 August 2016.

Basis of preparation

The financial statements of the Group have been prepared in accordance with New Zealand generally accepted accounting practice. The financial statements comply with NZ IFRS, and other applicable financial reporting standards, as appropriate for Tier 1 for-profit entities. The financial statements also comply with IFRS.

The accounting policies set out below have been applied consistently to all periods presented in these financial statements.

The consolidated financial statements have been prepared on an historical cost basis, with the exception of derivative financial instruments that have been measured at fair value. The financial statements are presented in New Zealand dollars, the functional currency of the Group, and all values are rounded to the nearest thousand dollars ($000).

Foreign currency transactions are translated into the functional currency, using the exchange rates prevailing at the dates of the transactions. Foreign exchange gains and losses resulting from the settlement of such transactions are recognised in the profit or loss.

New standards

None of the new standards effective after 1 July 2015 had a material effect on the Group.

Standards, amendments and interpretations issued but not yet effective

Standard/Interpretation	Effective for annual reporting periods beginning on or after	Expected to be initially applied in the financial year ending
NZ IAS 1 amendments – disclosure	1 January 2016	30 June 2017
NZ IFRS 9 Financial Instruments	1 January 2018	30 June 2019
IAS 16 and NZ IAS 38 Acceptable methods of depreciation and amortisation	1 January 2016	30 June 2017

The above standards and interpretations are not expected to have a material impact on the financial results. Except for the impending changes noted above there are no other standards or interpretations applicable to the Group that have been issued but are not yet effective.

Subsidiaries

Where the Group has the capacity to control the financing and operating policies of an entity, so as to obtain benefits from its activities, all such entities are consolidated as subsidiaries within the Group financial statements. This power exists where the Group controls the majority voting power on the governing body, or where such policies have been irreversibly predetermined by the Group, or where the determination of such policies is unable to materially impact the level of potential ownership benefits that arise from the activities of the subsidiary.

The Group measures the cost of a business combination as the aggregate of the fair values, at the date of exchange, of assets given, liabilities incurred or assumed, in exchange for control of the subsidiary plus any costs directly attributable to the business combination. Any excess of the cost of the business combination over the Group's interest in the net fair value of the identifiable assets, liabilities and contingent liabilities is recognised as goodwill. If the Group's interest in the net fair value of the identifiable assets, liabilities and contingent liabilities recognised exceeds the cost of the business combination, the difference will be recognised immediately in the profit or loss.

Basis of consolidation

The purchase method is used to prepare the consolidated financial statements; this involves adding together like items of assets, liabilities, equity, income and expenses on a line-by-line basis. All significant intragroup balances, transactions, income and expenses are eliminated on consolidation.

Landcare Research New Zealand Limited's investment in its subsidiaries is carried at cost less impairment in its 'Parent entity' financial statements.

Revenue

Revenue is measured at the fair value of consideration received.

Revenue from the rendering of services is recognised by reference to the stage of completion of the transaction at balance date, based on the actual service provided as a percentage of the total services to be provided. Income received for goods and services which have not yet been supplied to customers has been recognised as Revenue in Advance. Sales of goods are recognised when a product is sold to the customer.

Core Funding from the Ministry of Business, Innovation and Employment (MBIE) is treated as a government grant and generally recognised in the year of receipt. The only exception is where MBIE gives prior written consent to carry over to the next financial year any part of the Core Funding that will be allocated to specified long term or large scale research activities that require the accumulation of funds over two or more financial years to fully fund those activities.

Interest income is recognised using the effective interest method, whereby the estimated future cash receipts are exactly discounted from the net carrying amounts through the expected life of the financial assets.

Dividends are recognised when the right to receive payment has been established.

Borrowing costs

Borrowing costs directly attributable to the acquisition, construction or production of a qualifying asset (i.e. an asset that necessarily takes a substantial period of time to get ready for its intended use or sale) are capitalised as part of the cost of that asset in accordance with NZ IAS 23 Borrowing Costs (revised). All other borrowing costs are expensed in the period they occur.

Borrowing costs consist of interest and other costs that an entity incurs in connection with the borrowing of funds.

Income tax

Income tax expense in relation to the profit or loss for the period comprises current tax and deferred tax.

Current tax is the amount of income tax payable based on the taxable profit for the current year, plus any adjustments to income tax payable in respect of prior years. Current tax is calculated using rates that have been enacted or substantively enacted by balance date.

Deferred tax is the amount of income tax payable or recoverable in future periods in respect of temporary differences and unused tax losses. Temporary differences are differences between the carrying amount of assets and liabilities in the financial statements and the corresponding tax bases used in the computation of taxable profit. Deferred tax *liabilities* are generally recognised for all taxable temporary differences. Deferred tax *assets* are recognised to the extent that it is probable that taxable profits will be available against which the deductible temporary differences or tax losses can be utilised. Deferred tax is not recognised if the temporary difference arises from the initial recognition of goodwill, or from the initial recognition of an asset and liability in a transaction that is not a business combination, and at the time of the transaction affects neither accounting profit nor taxable profit. Deferred tax is recognised on taxable temporary differences arising on investments in subsidiaries and associates, and interests in joint ventures, except where the Company can control the reversal of the temporary difference and it is probable that

the temporary difference will not reverse in the foreseeable future. Deferred tax is calculated at the tax rates that are expected to apply in the period when the liability is settled or the asset is realised, using tax rates that have been enacted or substantively enacted by balance date.

Current tax and deferred tax are recognised against the profit or loss, except to the extent that they relate to a business combination, or to transactions recognised in other comprehensive income or directly in equity.

Finance leases

A finance lease is a lease that substantially transfers to the lessee all risks and rewards incidental to ownership of an asset, whether or not title is eventually transferred.

At the commencement of the lease term, the Group recognises finance leases as assets and liabilities in the Statement of Financial Position at the lower of the fair value of the leased item or the present value of the minimum lease payments. The amount recognised as an asset is depreciated over its useful life. If there is no certainty as to whether the Group will obtain ownership at the end of the lease term, the asset is fully depreciated over the shorter of the lease term or its useful life.

Operating leases

An operating lease is a lease that does not substantially transfer all the risks and rewards incidental to ownership of an asset. Lease payments under an operating lease are recognised as an expense on a straight-line basis over the lease term. Lease incentives received are recognised evenly over the term of the lease as a reduction in rental expense.

Cash and cash equivalents

Cash and cash equivalents include cash in hand, deposits held at call with banks, other short-term highly liquid investments with original maturities of three months or less, and bank overdrafts. Bank overdrafts are shown within borrowings in current liabilities in the Statement of Financial Position.

Trade and other receivables

Trade and other receivables are initially measured at fair value and subsequently measured at amortised cost, using the effective interest method, less any provision for impairment.

Loans are initially recognised at the present value of their expected future cash flows, discounted at the current market rate of return for a similar asset/investment. They are subsequently measured at amortised cost using the effective interest method. The difference between the face value and present value of expected future cash flows of the loan is recognised in the Statement of Comprehensive Income as a grant.

A provision for impairment of receivables is established when there is objective evidence that the Group will not be able to collect all amounts due according to the original terms of receivables. The amount of the provision is the difference between the asset's carrying amount and the present value of estimated future cash flows, discounted using the effective interest method.

Inventories

Inventories (such as spare parts and other items) held for distribution or consumption in the provision of services that are not supplied on a commercial basis are measured at the lower of cost and net realisable value. Inventories held for use in the production of goods and services on a commercial basis are valued at the lower of cost and net realisable value. The cost of purchased inventory is determined using the average cost method.

The write-down from cost to net realisable value is recognised in the profit or loss.

Financial assets

The Group classifies its financial assets into the following three categories: financial assets at fair value through profit or loss; loans and receivables; and financial assets at fair value through other comprehensive income. The classification depends on the purpose for which the investments were acquired. Management determines the classification of its investments at initial recognition and re-evaluates this designation at every reporting date.

Financial assets and liabilities are initially measured at fair value plus transaction costs unless they are carried at fair value through profit or loss, in which case the transaction costs are recognised in the profit or loss.

The fair value of financial instruments traded in active markets is based on quoted market prices at the balance sheet date. The quoted market price used is the current bid price. The fair value of financial instruments that are not traded in an active market is determined using valuation techniques. The Group uses a variety of methods and makes assumptions that are based on market conditions existing at each balance date. Quoted market prices or dealer quotes for similar instruments are used for long-term debt instruments held. Other techniques, such as estimated discounted cash flows, are used to determine fair value for the remaining financial instruments.

The three categories of financial assets are:

- *Financial assets at fair value through profit or loss*

This category has two sub-categories: financial assets held for trading; and those designated at fair value through profit or loss at inception. A financial asset is classified in this category if acquired principally for the purpose of selling

in the short term, or if designated as so by management. Derivatives are also categorised as held for trading unless they are designated as hedges. Assets in this category are classified as current assets if they are either held for trading or are expected to be realised within 12 months of the balance sheet date. After initial recognition they are measured at their fair values. Gains or losses on remeasurement are recognised in the profit or loss. Financial assets in this category include foreign currency forward contracts.

- *Loans and receivables*

These are non-derivative financial assets with fixed or determinable payments that are not quoted in an active market. After initial recognition they are measured at amortised cost using the effective interest method. Gains and losses when the asset is impaired or derecognised are recognised in the profit or loss. 'Trade and other receivables' are classified as loans and receivables in the Statement of Financial Position.

- *Financial assets at fair value through other comprehensive income*

Financial assets at fair value through other comprehensive income are those that are designated as fair value through other comprehensive income or are not classified in any of the other categories above. This category encompasses:

- Investments that the Group intends to hold long term but which may be realised before maturity
- Shareholdings that the Group holds for strategic purposes. The Parent's investments in its subsidiaries are not included in this category as they are held at cost (as allowed by NZ IAS 27 *Consolidated and Separate Financial Statements*) whereas this category is to be measured at fair value
- Investment in Kiwi Innovation Network Limited.

After initial recognition, these investments are measured at their fair value. Gains and losses are recognised directly in other comprehensive income except for impairment losses, which are recognised in the profit or loss. In the event of impairment, any cumulative losses previously recognised in other comprehensive income will be removed from other comprehensive income and recognised in the profit or loss even though the asset has not been derecognised. On derecognition, the cumulative gain or loss previously recognised in other comprehensive income is recognised in the profit or loss.

Impairment of financial assets

At each balance sheet date the Group assesses whether there is any objective evidence that a financial asset or group of financial assets is impaired. Any impairment losses are recognised in the profit or loss.

Accounting for derivative financial instruments and hedging activities

The Group uses derivative financial instruments to cover the risk on foreign exchange. In accordance with its treasury policy, the Group does not hold or issue derivative financial instruments for trading purposes.

Derivatives are initially recognised at fair value on the date a derivative contract is entered into and are subsequently remeasured at their value. The Group does not designate derivatives as a hedging instrument and therefore accounts for derivative instruments at fair value through profit or loss. Changes in the fair value of derivative instruments are recognised immediately in the profit or loss.

Non-current assets held for sale

Non-current assets held for sale are classified as held for sale if their carrying amount will be recovered principally through a sale transaction, not through continuing use. Non-current assets held for sale are measured at the lower of their carrying amount and fair value less costs to sell. Any impairment losses for write-downs of non-current assets held for sale are recognised in the profit or loss.

Any increases in fair value (less costs to sell) are recognised up to the level of any impairment losses that have been previously recognised. Non-current assets (including those that are part of a disposal group) are not depreciated or amortised while they are classified as held for sale. Interest and other expenses attributable to the liabilities of a disposal group classified as held for sale continue to be recognised.

Property, plant and equipment

Property, plant and equipment consist of:

- *Operational assets* – these include land, buildings, library books, plant and equipment, and motor vehicles
- *Restricted assets* – these are collections and databases, held by the Group, that provide a benefit or service to the community and cannot be disposed of because of legal or other restrictions
- *Capital work in progress* – this has been included within plant and equipment, and is not depreciated until ready for use.

Property, plant and equipment are shown at cost, less accumulated depreciation and impairment losses. Assets are not reported with a financial value in cases where they are not realistically able to be reproduced or replaced, and when they do not generate cash flows and where no market exists to provide a valuation.

Additions

The cost of an item of property, plant and equipment is recognised as an asset if, and only if, it is probable that

future economic benefits or service potential associated with the item will flow to the Group and the cost of the item can be measured reliably. In most instances, an item of property, plant and equipment is recognised at its cost. Where an asset is acquired at no cost, or for a nominal cost, it is recognised at fair value as at the date of acquisition.

Disposals
Gains and losses are determined by comparing the proceeds with the carrying amount of the asset. Gains and losses on disposals are included in the profit or loss.

Subsequent costs
Costs incurred subsequent to initial acquisition are capitalised only when it is probable that future economic benefits or service potential associated with the item will flow to the Group and the cost of the item can be measured reliably.

Depreciation
Depreciation is provided on the Group's property, plant and equipment, other than land, at rates that will write off the cost of the assets to their estimated residual values over their useful lives. All Parent and Enviro-Mark Solutions depreciable assets are depreciated on a straight-line (SL) basis. The residual value and useful life of an asset is reviewed, and adjusted if applicable, at each financial year end.

Depreciation rates	Parent and Enviro-Mark Solutions
Buildings	1.67–10%
Plant and equipment	4–33%
IT equipment	25%
Motor vehicles	25%
Furniture and fittings	6.67–10%
Office equipment	20%
Finance lease assets	20%
Library books and periodicals	20–50%
Rare books collections	1%

Intangible assets

Software acquisition and website development costs
Acquired computer software licences are capitalised on the basis of the costs incurred to acquire and bring to use the specific software. Costs associated with maintaining computer software and websites are recognised as an expense when incurred. Costs that are directly associated with the development of software and websites for internal use by the Group are recognised as an intangible asset. Direct costs include the software development employee costs and an appropriate portion of relevant overheads.

Patents and intellectual property
Patents and intellectual property are capitalised on the basis of costs incurred. The useful life of trade marks is assessed as being indefinite as the trade mark is renewed every ten years by paying the applicable fee, and continues in use.

Amortisation
The carrying value of an intangible asset with a finite life is amortised on a straight-line basis over its useful life. Amortisation begins when the asset is available for use and ceases at the date that the asset is derecognised. The amortisation charge for each period is recognised in the profit or loss. The useful lives and associated amortisation rates of major classes of intangible assets have been estimated as follows:

Computer software	4 years	25%
Intellectual property	3–20 years	5–35%

Impairment of non-financial assets

Non-financial assets that have an indefinite useful life are not subject to amortisation and are tested annually for impairment. Assets that have a finite useful life are reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount may not be recoverable. An impairment loss is recognised for the amount by which the asset's carrying amount exceeds its recoverable amount. The recoverable amount is the higher of an asset's fair value less costs to sell and value in use.

Value in use is depreciated replacement cost for an asset where the future economic benefits or service potential of the asset are not primarily dependent on the asset's ability to generate net cash inflows and where the entity would, if deprived of the asset, replace its remaining future economic benefits or service potential. The value in use for cash-generating assets is the present value of expected future cash flows.

If an asset's carrying amount exceeds its recoverable amount the asset is impaired and the carrying amount is written down to the recoverable amount. The total impairment loss is recognised in the profit or loss.

Employee benefits

Short-term benefits

Employee benefits that the Group expects to be settled within 12 months of balance date are measured at nominal values based on accrued entitlements at current rates of pay. These include salaries and wages accrued up to balance date, annual leave earned to but not yet taken at balance date, retirement and long-service leave entitlements expected to be settled within 12 months, and sick leave.

The Group recognises a liability for sick leave to the extent that absences in the coming year are expected to be greater than the sick leave entitlements earned in the coming year. The amount is calculated based on the unused sick leave entitlement that can be carried forward at balance date to the extent that the Group anticipates leave entitlements will be used by staff to cover those future absences.

The Group recognises a liability and an expense for bonuses where contractually obliged or where there is a past practice that has created a constructive obligation.

All actuarial gains and losses that arise subsequent to the transition date in calculating the Group's obligation with respect to long-service leave, retirement gratuities and sick leave are recognised as an expense in the profit or loss.

Superannuation schemes

- Defined contribution schemes: obligations for contributions to defined-contribution superannuation schemes are recognised as an expense in the profit or loss as incurred.
- Defined benefit schemes: the Group makes contributions to the Government Superannuation Fund, which is a multi-employer defined benefit scheme. Insufficient information is available to use defined benefit accounting, as it is not possible to determine from the terms of the scheme the extent to which the profit or loss will affect future contributions by individual employers, as there is no prescribed basis for allocation. The scheme is therefore accounted for as a defined contribution scheme.

Long-service leave, retirement leave and sick leave

Entitlements that are payable beyond 12 months, such as long-service leave, retirement leave and sick leave, have been calculated on an actuarial basis. The calculations are based on likely future entitlements accruing to staff, based on years of service, years to entitlement, payment history, the likelihood that staff will reach the point of entitlement, and contractual entitlements information.

Provisions

The Group recognises a provision for future expenditure of uncertain amount or timing when there is a present obligation (either legal or constructive), as a result of a past event, that probable expenditures will be required to settle the obligation, and a reliable estimate can be made of the amount of the obligation. Provisions are not recognised for future operating losses. Provisions are measured at the present value of the expenditures expected to be required to settle the obligation, using a pre-tax discount rate that reflects current market assessments of the time value of money and the risks specific to the obligation. The increase in the provision due to the passage of time is recognised as an interest expense.

Borrowings

Borrowings are initially recognised at their fair value. After initial recognition, all borrowings are measured at amortised cost, using the effective interest method.

Goods and Services Tax (GST)

All items in the financial statements are stated exclusive of GST, except for receivables and payables, which are stated on a GST-inclusive basis. Where GST is not recoverable as input tax then it is recognised as part of the related asset or expense.

The net amount of GST recoverable from, or payable to, the Inland Revenue Department (IRD) is included as part of receivables or payables in the Statement of Financial Position. The net GST paid to or received from the IRD, including the GST relating to investing and financing activities, is classified as an operating cash flow in the Statement of Cash Flows.

Commitments and contingencies are disclosed exclusive of GST.

Budget figures

The budget figures are those in the Statement of Corporate Intent approved by the shareholding Ministers at the beginning of the year. The budget figures have been prepared in accordance with NZ GAAP, using accounting policies that are consistent with those adopted by the Group for the preparation of the financial statements.

Critical accounting estimates and assumptions

In preparing these financial statements the Group has made estimates and assumptions concerning the future. These estimates and assumptions may differ from the subsequent actual results. Estimates and judgements are continually evaluated and are based on historical experience and other

factors, including expectations or future events that are believed to be reasonable under the circumstances. The estimates and assumptions that have a significant risk of causing a material adjustment to the carrying amounts of assets and liabilities within the next financial year are discussed below:

Revenue recognition
The Group uses the percentage-of-completion method in accounting for its fixed-price contracts to deliver research services. Use of the percentage-of-completion method requires the Group to estimate the services performed to date as a proportion of the total services to be performed.

Critical judgements in applying the Group's accounting policies

Management has exercised the following critical judgements in applying the Group's accounting policies for the year ended 30 June 2016:

1. Leases classification
Determining whether a lease agreement is a finance or an operating lease requires judgement as to whether the agreement transfers substantially all the risks and rewards of ownership to the Company.

Judgement is required on various aspects that include, but are not limited to, the fair value of the leased asset, the economic life of the leased asset, whether or not to include renewal options in the lease term, and determining an appropriate discount rate to calculate the present value of the minimum lease payments. Classification as a finance lease means the asset is recognised in the Statement of Financial Position as property, plant and equipment, whereas for an operating lease no such asset is recognised.

The Group has exercised its judgement on the appropriate classification of property and equipment leases and has determined that one lease arrangement is a finance lease.

2. Patents and intellectual property impairment
The Company has exercised judgement on the impairment assessment of patents and intellectual property. Determination as to whether and how much an asset is impaired involves director and management estimates on highly uncertain matters such as local and international changes in legislation, the continuation of existing customers with existing contracts, the outlook for global and local markets, and the level at which future contracts are based on assumptions that are consistent with the company's business plan and long-term decisions.

Changes in accounting policies

There were no changes in accounting policies during the financial year.

Changes in accounting estimates

A review of the useful life of the Godley building on the Lincoln site has been carried out and its useful life has been realigned to our best estimate. Additional depreciation of $300k has been included in the accounts for the year ended 30 June 2016.

2 REVENUE

	Group 2016 Actual $000s	Group 2015 Actual $000s
Revenue from operations consisted of the following items:		
Research contracts funded by the Crown via Ministry of Business, Innovation and Employment		
Core	24,205	24,205
Other	9,136	9,357
Other New Zealand revenue	20,543	21,768
International revenue	3,000	2,883
Interest revenue:		
Bank deposits	223	154
Finance leases	50	59
Total interest	273	213
Total revenue	**57,157**	**58,426**

3 PROFIT BEFORE INCOME TAX

	Group 2016 Actual $000s	Group 2015 Actual $000s
Profit before income tax has been arrived at after charging the following expenses:		
Finance costs:		
Interest on loans	21	0
Inventory write off	0	24
Employee remuneration	29,079	29,501
Restructuring costs	122	755
Superannuation contributions	1,178	1,176
Employee entitlements increase/(decrease)	(242)	172
Net bad and doubtful debts	33	2
Donations	0	1
Auditor's remuneration:		
Audit New Zealand – audit services	141	139
Audit New Zealand – other services	1	1
Directors' fees	237	217
Depreciation and amortisation of property, plant, equipment and intangibles	4,262	4,303
Loss on sale of non-current assets	46	9
Operating lease rental	791	960
Cost of sales	489	518
Movement in inventory	(1)	(26)
Loss/(Profit) on foreign currency contracts fair value	12	(40)

4 CASH AND CASH EQUIVALENTS

	Group 2016 Actual $000s	Group 2015 Actual $000s
Cash at bank and in hand	1,289	318
Short-term deposits maturing three months or less from date of acquisition	7,693	5,277
Total cash and cash equivalents	**8,982**	**5,595**

The carrying value of short-term deposits with maturity dates of three months or less approximates their fair value.

Cash and bank overdrafts include the following for the purposes of the cash flow statement:

Cash at bank and in hand	1,289	318
Short-term deposits maturing three months or less from date of acquisition	7,693	5,277
	8,982	**5,595**
Short Term Deposits		
Short-term deposits maturing within five months	**6,049**	**0**

5 TRADE AND OTHER RECEIVABLES

	Group 2016 Actual $000s	Group 2015 Actual $000s
Trade debtors	6,063	7,268
Accrued income and sundry debtors	30	504
Prepayments	771	897
	6,864	8,669
Less provision for impairment of receivables	(46)	0
Total trade and other receivables	**6,818**	**8,669**
Total non-current portion	**0**	**0**
Total current portion of trade & other receivables	**6,818**	**8,669**

The carrying value of trade and other receivables approximates their fair value.

Apart from the Ministry of Business, Innovation and Employment, which is Government owned, there is no concentration of credit risk to receivables outside the Group, as the Group has a large number of customers.

As of 30 June 2016, all overdue receivables have been assessed for impairment and appropriate provisions applied. Landcare Research holds no collateral as security or other credit enhancements over receivables that are either past due or impaired. The impairment provision has been calculated based on expected losses for Landcare Research's pool of debtors. Expected losses have been determined based on review of specific debtors.

Movements in the provision for impairment of receivables are as follows:

As at 1 July	0	18
Additional provisions made during the year	46	0
Receivables written off during the period	0	(18)
As at 30 June	**46**	**0**

Age of trade debtors:		
Current	5,194	6,210
Outstanding	869	1,058
Total trade debtors	**6,063**	**7,268**

6 INVENTORIES

	Group	
	2016 Actual $000s	2015 Actual $000s
Finished goods	15	16
Total inventories	**15**	**16**

Inventories are valued at the lower of cost and net realisable value.
Inventory cost includes the cost of direct materials.
Net realisable value is the estimated selling price in the ordinary course of business less estimated costs necessary to make the sale.

7 ANALYSIS OF FINANCE LEASE RECEIVABLE

	Group	
	2016 Actual $000s	2015 Actual $000s
Total minimum lease payments are receivable:		
Not later than one year	78	143
Later than one year and not later than five years	314	314
Later than five years	373	451
Total minimum lease payments	765	908
Future finance charges	(257)	(306)
Total present value of minimum lease payments	**508**	**602**
Present value of minimum lease payments are receivable:		
Not later than one year	34	94
Later than one year and not later than five years	172	157
Later than five years	302	351
Total	**508**	**602**
Current	34	94
Non-current	474	508
Total	**508**	**602**

Finance lease receivable relates to the animal house facility. The building transfered to Lincoln University for nil in 2016. Landcare Research New Zealand Limited has the right to continue occupying the building for a further 10 years to 2026 at a rent of $1.00 per annum.

8 DERIVATIVE FINANCIAL INSTRUMENTS

Current asset/(liability) portion

Foreign currency forward contracts	(12)	40
Total derivative financial instruments	**(12)**	**40**

9 PROPERTY, PLANT AND EQUIPMENT

2015	Group Land $000s	Buildings $000s	Plant & equipment $000s	Library assets $000s	Total $000s
Cost at 1 July 2014	519	26,480	44,505	6,395	**77,899**
Accumulated depreciation and impairment charges	0	(8,235)	(31,263)	(5,234)	**(44,732)**
Net book value at the beginning of the year	519	18,245	13,242	1,161	**33,167**
Year ended 30 June 2015					
Net book value at the beginning of the year	519	18,245	13,242	1,161	33,167
Additions	0	52	1,716	434	2,202
Disposals and transfers	0	0	(254)	0	(254)
Accumulated depreciation on disposals and transfers	0	0	231	0	231
Current year depreciation	0	(485)	(2,923)	(469)	(3,877)
Net book value at the end of the year	519	17,812	12,012	1,126	**31,469**
At 30 June 2015					
Cost	519	26,532	45,967	6,829	**79,847**
Accumulated depreciation	0	(8,720)	(33,955)	(5,703)	**(48,378)**
Net book value at the end of the year	519	17,812	12,012	1,126	**31,469**

2016	Group Land $000s	Buildings $000s	Plant & equipment $000s	Library assets $000s	Total $000s
Cost at 1 July 2015	519	26,532	45,967	6,829	**79,847**
Accumulated depreciation and impairment charges	0	(8,720)	(33,955)	(5,703)	**(48,378)**
Net book value at the beginning of the year	519	17,812	12,012	1,126	**31,469**
Year ended 30 June 2016					
Net book value at the beginning of the year	519	17,812	12,012	1,126	**31,469**
Additions	0	(14)	2,276	481	**2,743**
Disposals and transfers	0	(116)	(576)	0	**(692)**
Accumulated depreciation on disposals and transfers	0	69	523	0	**592**
Current year depreciation	0	(773)	(2,638)	(460)	**(3,871)**
Net book value at the end of the year	519	16,978	11,597	1,147	**30,241**
At 30 June 2016					
Cost	519	26,402	47,668	7,310	**81,899**
Accumulated depreciation	0	(9,424)	(36,071)	(6,163)	**(51,658)**
Net book value at the end of the year	519	16,978	11,597	1,147	**30,241**

Heritage assets

Heritage collection assets are those assets held for the duration of their physical lives because of their unique scientific importance. The Crown, when establishing Crown Research Institutes in 1992, transferred various national databases and reference collections to individual Institutes at nil value. Many of these databases and collections were specifically identified by the Foundation for Research, Science and Technology as being of significant national importance, and they have covenants attached to them restricting an Institute's ability to deal with them.

Landcare Research has the following nationally significant collections and databases that have been defined as heritage assets:

- The New Zealand Arthropod Collection (NZAC), including the New Zealand National Nematode Collection (NZNNC) and associated database NZACbugs, BUGS bibliography and Pacific database
- The New Zealand Fungal & Plant Disease Herbarium (PDD)
- The International Collection of Micro-Organisms from Plants (ICMP) and associated NZFungi Database
- The Allan Herbarium
- The National Vegetation Survey Databank (NVS)
- The 'Ngā Tipu Whakaoranga' Ethnobotany Database and New Zealand Flax and Living Plant collections

Further details on these heritage assets are shown in the company's Statement of Corporate Intent pages 34 and 35.

The nature of these heritage assets and their significance to the science and research that Landcare Research undertakes make it necessary to disclose them.

No reliable valuation is able to be obtained for these assets, and so they remain at nil value.

A rare books collection, previously considered to be part of the reference collections, was introduced in 2002/03 on a market value basis. This value has been accepted as deemed cost.

10 PATENTS AND INTELLECTUAL PROPERTY

	Group Actual $000s
As at 1 July 2014	
Cost	525
Accumulated amortisation and impairment	(19)
Net book amount	**506**
Year ended 30 June 2015	
Opening net book amount	506
Additions	41
Disposals/transfers	0
Amortisation charge	(3)
Closing net book amount	**544**
As at 1 July 2015	
Cost	566
Accumulated amortisation and impairment	(22)
Net book amount	**544**
Year ended 30 June 2016	
Opening net book amount	544
Additions	28
Disposals/transfers	(27)
Amortisation on disposals/transfers	(4)
Amortisation charge	(2)
Closing net book amount	**539**
As at 30 June 2016	
Cost	562
Accumulated amortisation and impairment	(23)
Net book amount	**539**

Landcare Research Group has patents and trademarks amounting to $539,000 (2015: $544,000), which are carried at an indefinite life in the financial statements. These assets have not been impaired during the year (2015: no impairment writedown). Landcare Research has not recognised an impairment charge, as these assets are still used by the business.

11 INTANGIBLE ASSETS

	Group Actual $000s
As at 1 July 2014	
Cost	5,600
Accumulated amortisation and impairment	(4,597)
Net book amount	**1,003**
Year ended 30 June 2015	
Opening net book amount	1,003
Additions	142
Amortisation charge/impairment charge	(427)
Closing net book amount	**718**
As at 30 June 2015	
Cost	5,742
Accumulated amortisation and impairment	(5,024)
Net book amount	**718**
Year ended 30 June 2016	
Opening net book amount	718
Additions	124
Disposals/transfers	(274)
Amortisation on disposals/transfers	274
Amortisation/impairment charge	(391)
Closing net book amount	**451**
As at 30 June 2016	
Cost	5,066
Accumulated amortisation and impairment	(4,615)
Net book amount	**451**

12 INVESTMENTS

	Group 2016 Actual $000s	 2015 Actual $000s
Investment in Landcare Research US Limited	0	0
Total investments	**0**	**0**

Landcare Research New Zealand Limited has 100% interest in Landcare Research US Limited and Enviro-Mark Solutions Limited (previously called carboNZero Holdings Limited).

On 29 June 2016 Landcare Research New Zealand Limited subscribed for twenty percent of Lincoln Hub Limited.

The subsidiaries are unlisted companies, and accordingly, there are no published price quotations to determine the fair value of these investments, therefore, they are accounted at cost less impairment as per the accounting policies.

Landcare Research New Zealand Limited has a 49% share in Staron LLC. This Company is non-trading.

13 TRADE AND OTHER PAYABLES

	Group	
	2016 Actual $000s	2015 Actual $000s
Trade payables	3,726	3,966
Amounts due to directors	(5)	5
GST & PAYE	925	1,240
Sundry creditors and accruals	1,222	851
Total trade and other payables	**5,868**	**6,062**

The carrying value of trade and other payables approximates their fair value.

14 EMPLOYEE BENEFIT LIABILITIES

	Group	
	2016 Actual $000s	2015 Actual $000s
Accrued pay	104	0
Annual leave	1,932	2,037
Long-service leave	1,084	1,165
Retirement leave	19	19
Time in lieu	130	126
Sick leave	60	59
Staff incentives and at risk payments	818	852
Holiday pay due to ex employees	473	0
Restructuring provision	130	650
Total employee benefit liabilities	**4,750**	**4,908**
Comprising:		
Current	4,068	4,214
Non-current	682	694
Total	**4,750**	**4,908**

The Holiday Pay due to ex employees of $473,000 has been provided for due to the payroll system incorrectly calculating annual leave payment rates. The provision is the maximum amount that is required to be paid out.

Entitlements that are payable beyond 12 months, such as long-service leave and retirement leave, have been calculated on an actuarial basis by Eriksen and Associates Limited as at 30 June 2016. The calculations are based on:

- Likely future entitlements accruing to staff, based on years of service, years to entitlement, likelihood staff will reach the point of entitlement and contractual entitlements information; and
- Present value of estimated future cash flows using the following key assumptions:
  - Discount rates of 2.03% – 4.75% based on the risk-free rates as calculated from the yields on New Zealand Government Bonds
  - Inflation factor of 2.5% was based on the expected long-term increase in remuneration of employees.

Staff incentives and at risk payments include a contracted profit share of $392,000 (2015 $437,000).

The Parent Company's Profit Share Policy establishes a contractual Profit Share Scheme which provides a means for staff to share in the Company's profits. Any changes to the scheme during its existence require ratification by staff who are eligible Public Service Association members.

15 REVENUE IN ADVANCE

	Group	
	2016 Actual $000s	2015 Actual $000s
MBIE public good science funding	4,537	562
Commercial contracts	1,379	1,055
	5,916	**1,617**

The carrying value of revenue in advance approximates fair value.

16 EQUITY

	Group	
	2016 Actual $000s	2015 Actual $000s
Retained earnings		
As at 1 July	21,017	19,343
Profit / (loss) for the year	2,187	1,674
As at 30 June	**23,204**	**21,017**
Share capital		
As at 1 July	10,515	10,515
As at 30 June	**10,515**	**10,515**

The issued capital of the company is 10,515,000, fully paid up, and equally ranking shares.
The shares have no par value.
No Dividends were paid during the year ended 30 June 2016. (2015: $0).

17 CAPITAL MANAGEMENT

The Group's capital is its equity, which comprises retained earnings and other reserves. Equity is represented by net assets.

The Group is subject to the financial management and accountability provisions of the Crown Research Institutes Act 1992, which imposes certain restrictions in relation to borrowings, acquisition of securities, issuing guarantees and indemnities and the use of derivatives.

The Group manages its equity as a by-product of prudently managing revenues, expenses, assets, liabilities, investments, and general financial dealings to ensure the Group effectively achieves its objectives and purpose, while remaining a going concern.

18 RECONCILIATION OF NET PROFIT / (LOSS) AFTER TAX TO NET CASH FLOW FROM OPERATING ACTIVITIES

	Group	
	2016 Actual $000s	2015 Actual $000s
Profit / (loss) after tax	2,187	1,674
Add/(less) non-cash items:		
Depreciation and amortisation	4,262	4,303
Movement in non-current employee entitlements	(12)	128
Increase/(decrease) in deferred tax	(380)	(257)
Add/(less) items classified as investing or financing activities:		
Gain/(loss) in fair value of financial assets	52	(43)
Movement in finance lease receivable	94	106
Add/(less) movements in working capital items:		
Inventory	1	35
Trade and other receivables	1,940	(795)
Interest Receivable	(28)	0
Trade and other payables	160	580
Employee benefit liabilities	(146)	110
Revenue in advance	4,298	32
Net cash inflow/(outflow) from operating activities	**12,428**	**5,873**

19 CAPITAL COMMITMENTS AND OPERATING LEASES

	Group	
	2016 Actual $000s	2015 Actual $000s
Capital commitments		
Estimated capital expenditure contracted for at balance date but not paid or provided for	91	313
Operating lease commitments		
Lease commitments under non-cancellable operating leases:		
Within one year	689	721
Later than one year and not later than two years	481	445
Later than two years and not later than five years	894	995
Later than five years	3,212	3,464

In addition to the above, the Parent has $1m committed to New Zealand eScience Infrastructure.

20 CONTINGENCIES

The Group is not aware of any significant contingent liabilities as at balance date (2015:nil).

21 RELATED PARTY TRANSACTIONS

Landcare Research New Zealand Limited is the ultimate parent of the Group and controls three entities, being Landcare Research US Limited, Enviro-Mark Solutions Limited and Manaaki Whenua Research Trust (MWRT).

Manaaki Whenua Research Trust is incorporated under the Charitable Trusts Act 1957 and is registered as a charitable entity under the Charities Act 2005. The Trust is controlled by Landcare Research New Zealand Limited and was formed on 9 February 2016.

MWRT audit fees to Audit New Zealand of $1,744 have been paid by the Controlling Entity, Landcare Research New Zealand Limited.

MWRT Trustees Liability insurance of $2,750 has been paid by the Controlling Entity, Landcare Research New Zealand Limited.

MWRT's Controlling Entity, Landcare Research New Zealand Limited has provided accounting services to the Trust at no cost.

Intercompany transactions between Landcare Research New Zealand Limited and its subsidiaries and Controlled Trust are transacted on a commercial basis. No transaction between companies within the Landcare Research Group took place at nil or nominal value during the year, apart from the provision of accounting services to the Trust as stated previously.

The following transactions were carried out with related parties:	2016 Actual $000s	2015 Actual $000s
Enviro-Mark Solutions Limited:		
Services provided to Enviro-Mark Solutions Limited	168	163
Products and services provided by Enviro-Mark Solutions Limited	28	56
Loan outstanding	(215)	210
Intercompany current account receivable/(payable)	826	580
Subvention payment	0	23
Impairment of investment/receivable in subsidiary	0	208
Services provided by Enviro-Mark Solutions Limited - payable	11	14
Products and services provided to Enviro-Mark Solutions Limited - receivable	14	30
Landcare Research US Limited:		
Intercompany current account receivable/(payable)	(71)	(71)

Landcare Research New Zealand Limited has capitalised Landcare Research US Limited for a sum of USD 50,000, but the amount has been held by the Parent company pending requirement, and will be paid out on request.

Lincoln Hub Limited:
No transactions occurred between the date of investment in Lincoln Hub Limited, 29 June 2016 and 30 June 2016.

	Group	
	2016	2015
	Actual	Actual
Key management personnel compensation	$000s	$000s
Salaries and other short-term employee benefits	2,684	2,470

Key management personnel include Directors, Chief Executive Officer and other senior management personnel.

During the year Director remuneration payments (including expense reimbursements) were made to the following entities at the request of the Directors and relate exclusively to Director remuneration payments that would have otherwise been paid directly to the existing Directors.

	2016	2015	2016	2015	2016	2015
	Services received from	Services received from	Services provided to	Services provided to	Amounts (Payable to)/ Receivable	Amounts (Payable to)/ Receivable
	$000s	$000s	$000s	$000s	$000s	$000s
Hall Family Trust	26	25	0	0	0	0
The Commonwealth Scientific & Industrial Research Organisation	23	21	0	0	0	0

During the year Landcare Research provided services to or received services from the following companies, in which Directors and Senior Management have declared an interest. These transactions were conducted on normal commercial terms. Related parties have ceased and commenced during the year due to changes in directorships as noted.

	2016	2015	2016	2015	2016	2015
	Services received from	Services received from	Services provided to	Services provided to	Amounts (Payable to)/ Receivable	Amounts (Payable to)/ Receivable
	$000s	$000s	$000s	$000s	$000s	$000s
AgResearch	549	0	2,011	0	680	0
Dairy NZ Ltd	0	1	0	98	0	0
Enviro-Mark Solutions Limited	28	56	168	163	3	(16)
Hirepool Limited	67	6	0	0	(13)	0
Maurice Wilkins Centre	0	0	1	0	0	0
Plus Group Horticulture Limited	0	0	1	0	0	0
Science New Zealand	59	68	30	29	(12)	(12)
Silver Fern Farms Limited	0	0	1	4	0	0
Sustainable Business Council	12	12	0	30	0	0
The Commonwealth Scientific & Industrial Research Organisation	112	119	0	1	0	0
The Royal Society of New Zealand	15	0	298	0	2	0
University of Canterbury	351	157	84	75	(204)	(57)

In conducting its activities Landcare Research New Zealand Limited is required to pay various taxes and levies (such as GST, FBT, PAYE and ACC levies) to the Crown and entities related to the Crown. The payment of these levies and taxes, other than income tax, is based on the standard terms that apply to all tax and levy payers.

Landcare Research New Zealand Limited also supplies and purchases goods and services from entities controlled, significantly influenced or jointly controlled by the Crown. Sales to and purchases from these entities during the year ended 30 June 2016 were:

	2016	2015	2016	2015	2016	2015
	Services received from $000s	Services received from $000s	Services provided to $000s	Services provided to $000s	Amounts (Payable to)/ Receivable $000s	Amounts (Payable to)/ Receivable $000s
Crown entities, SOEs and government departments	7,327	6,167	47,679	46,238	876	1,987

22 EVENTS AFTER THE BALANCE SHEET DATE

Nil to report

23 FINANCIAL INSTRUMENT RISKS

The Group has a series of policies to manage the risks associated with financial instruments. The Group is risk averse and seeks to minimise exposure from its treasury activities. Treasury and cash management policies approved by the Board do not allow any transactions that are speculative in nature to be entered into.

Market risk

Price risk

Group price risk is the risk that the value of a financial instrument will fluctuate as a result of changes in market prices. The Group is not exposed to price risk as it does not hold financial assets held at fair value through other comprehensive income and/or profit/loss.

Currency risk

Group currency risk is the risk that the value of a financial instrument will fluctuate due to changes in foreign exchange rates. The Group operates internationally and is exposed to foreign exchange risk arising from various contract exposures, primarily with respect to the US dollar, Australian dollar, Euro and UK pound. Currency risk arises when future commercial transactions, recognised assets and recognised liabilities are denominated in a currency that is not the entity's functional currency.

At 30 June 2016, if the US dollar had weakened/strengthened by 10% against the New Zealand dollar with all other variables held constant, profit after tax for the year would have been $5,000 (2015: $3,000) higher/lower, mainly as a result of foreign exchange gains/losses on translation of US-dollar-denominated trade payables and receivables and the US dollar bank account.

At 30 June 2016, if the Australian dollar had weakened/strengthened by 10% against the New Zealand dollar with all other variables held constant, profit after tax for the year would have been $10,000 (2015: $23,000) higher/lower, mainly as a result of foreign exchange gains/losses on translation of Australian-dollar-denominated trade payables and receivables and the Australian dollar bank account.

At 30 June 2016, if the Euro had weakened/strengthened by 10% against the New Zealand dollar with all other variables held constant, profit after tax for the year would have been $0 (2015: $1,000) higher/lower, mainly as a result of foreign exchange gains/losses on translation of Euro-denominated trade payables and receivables.

At 30 June 2016, if the UK pound had weakened/strengthened by 10% against the New Zealand dollar with all other variables held constant, profit after tax for the year would have been $3,000 (2015: $4,000) higher/lower, mainly as a result of foreign exchange gains/losses on translation of UK-pound-denominated trade payables and receivables.

The Group foreign exchange management policy is to cover the risk on any foreign currency transactions greater than $50,000.

Interest rate risk

Cash flow interest rate risk is the risk that the cash flows from a financial instrument will fluctuate due to changes in market interest rates. Short term bank deposits which receive variable interest rates expose the Group to cash flow interest rate risk.

Contractual maturity analysis of financial liabilities, excluding derivatives

The table below analyses the Group's financial liabilities into relevant maturity groupings based on the remaining period at balance date to the contractual maturity date. Future interest payments on floating rate debt are based on the floating rate on the instrument at balance date. The amounts disclosed are the contractual undiscounted cash flows and include interest payments.

2015	Carrying amount $000s	Contractual cash flows $000s	Less than 1 year $000s	1–2 years $000s	2–5 years $000s	More than 5 years $000s
Group						
Creditors & other payables	6,062	6,062	6,062	0	0	0
Total	**6,062**	**6,062**	**6,062**	**0**	**0**	**0**

2016	Carrying amount $000s	Contractual cash flows $000s	Less than 1 year $000s	1–2 years $000s	2–5 years $000s	More than 5 years $000s
Group						
Creditors & other payables	5,868	5,868	5,868	0	0	0
Total	**5,868**	**5,868**	**5,868**	**0**	**0**	**0**

Credit risk

Credit risk is the risk that a third party will default on its obligation to Landcare Research, causing Landcare Research to incur a loss. Landcare Research has a significant concentration of credit risk with the Ministry of Science and Innovation; however, the risk is mitigated as this entity is also Government owned. The Group's maximum exposure to credit risk is the amount of Receivables.

Liquidity risk

Liquidity risk is the risk that the Group will encounter difficulty raising liquid funds to meet commitments as they fall due. Prudent liquidity risk management implies maintaining sufficient cash and the availability of funding through an adequate amount of committed credit facilities. The Group aims to maintain flexibility in funding by keeping committed credit lines available.

24 TAXATION

	Group	
	2016 Actual $000s	2015 Actual $000s
Components of tax expense		
Current tax	1,237	924
Adjustments to current tax in prior years	8	72
Deferred tax expense	(381)	(256)
Income tax expense	**864**	**740**

	Group	
	2016 Actual $000s	2015 Actual $000s
Relationship between tax expense and accounting profit		
Profit / (loss) before tax	3,051	2,413
Tax at 28%	854	686
Non-deductible expenditure	11	7
Non-taxable income	(10)	44
Prior-year adjustment	9	3
Total income tax expense	**864**	**740**

Deferred tax assets/(liabilities)	Property, plant and equipment $000s	Employee entitlements $000s	Other provisions $000s	Total $000s
Group				
Balance at 1 July 2014	(3,975)	689	44	(3,243)
Charged to profit / (loss)	165	105	(13)	258
Balance at 1 July 2015	(3,810)	794	31	(2,985)
Charged to profit / (loss)	269	133	(16)	386
Balance at 30 June 2016	**(3,541)**	**927**	**15**	(2,599)

25 CATEGORIES OF FINANCIAL INSTRUMENTS

	Group	
	2016 Actual $000s	2015 Actual $000s
Financial assets		
Financial assets at fair value through profit and loss		
Foreign exchange forward contracts	(12)	40
Loans and receivables		
Cash and cash equivalents	8,982	5,595
Trade Receivables	6,063	7,268
Financial liabilities		
Other financial liabilities		
Trade payables	3,726	3,965

26 EXPLANATION OF SIGNIFICANT VARIANCES AGAINST BUDGET AND BETWEEN YEARS

There were the following significant variances:

Statement of Comprehensive Income

- June 2016 result was impacted by reduced contestible revenue offset by rigorous cost control measures.

Statement of Financial Position

- Cash on hand increased substantially over budget and prior year due to deferred capital expenditure and revenue received in advance of work being performed by the National Science Challenge (Bio-Heritage).

Statement of Responsibility

The Directors are responsible for presenting financial statements for each financial year that give a true and fair view of the financial position of Landcare Research New Zealand Limited (the Company) and its subsidiaries (the Group) and of the financial performance and cash flows for that period.

The Directors consider the financial statements of the Group and the Company have been prepared using appropriate accounting policies consistently applied and supported by reasonable judgements and estimates, and that all relevant financial reporting and accounting standards have been followed.

The Directors are responsible for establishing and maintaining a system of internal control designed to provide reasonable assurances as to the integrity and reliability of the financial reporting.

The Directors believe that proper accounting records have been kept, which enable, with reasonable accuracy, the determination of the financial position of the Group and facilitate compliance of the financial statements with the Companies Act 1993.

The Directors believe that they have taken adequate steps to safeguard the assets of the Group and to prevent and detect fraud and other irregularities.

The Board of Directors of Landcare Research New Zealand Limited approved and authorised the financial statements for the year ending 30 June 2016 for issue on 24 August 2016.

Jane Taylor
Chair

24 August 2016

Paul Reynolds
Deputy Chair

24 August 2016

AUDIT NEW ZEALAND
Mana Arotake Aotearoa

INDEPENDENT AUDITOR'S REPORT

To the readers of
Landcare Research New Zealand Limited's and Group's
financial statements
for the year ended 30 June 2016

The Auditor-General is the auditor of Landcare Research New Zealand Limited Group (the Group). The Auditor-General has appointed me, John Mackey, using the staff and resources of Audit New Zealand, to carry out the audit of the financial statements of the Group consisting of Landcare Research New Zealand Limited and its subsidiaries, on her behalf.

Opinion

We have audited the financial statements of the Group on pages 42 to 64, that comprise the statement of financial position as at 30 June 2016, the statement of comprehensive income, statement of changes in equity and statement of cash flows for the year ended on that date and the notes to the financial statements that include accounting policies and other explanatory information.

In our opinion, the financial statements of the Group:

- present fairly, in all material respects:
    - its financial position as at 30 June 2016;
    - its financial performance and cash flows for the year then ended; and
    - comply with generally accepted accounting practice in New Zealand in accordance with New Zealand Equivalents to International Financial Reporting Standards and International Financial Reporting Standards.

Our audit was completed on 24 August 2016. This is the date at which our opinion is expressed.

The basis of our opinion is explained below. In addition, we outline the responsibilities of the Board of Directors and our responsibilities, and explain our independence.

Basis of opinion

We carried out our audit in accordance with the Auditor-General's Auditing Standards, which incorporate the International Standards on Auditing (New Zealand). Those standards require that we comply with ethical requirements and plan and carry out our audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

Material misstatements are differences or omissions of amounts and disclosures that, in our judgement, are likely to influence readers' overall understanding of the financial statements. If we had found material misstatements that were not corrected, we would have referred to them in our opinion.

An audit involves carrying out procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on our judgement, including our assessment of risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, we consider internal control relevant to the preparation of the Group's financial statements in order to design audit procedures that are appropriate in the circumstances but not for the purpose of expressing an opinion on the effectiveness of the Group's internal control.

An audit also involves evaluating:

- the appropriateness of accounting policies used and whether they have been consistently applied;
- the reasonableness of the significant accounting estimates and judgements made by the Board of Directors;

- the adequacy of the disclosures in the financial statements; and
- the overall presentation of the financial statements.

We did not examine every transaction, nor do we guarantee complete accuracy of the financial statements. Also, we did not evaluate the security and controls over the electronic publication of the financial statements.

We believe we have obtained sufficient and appropriate audit evidence to provide a basis for our audit opinion.

Responsibilities of the Board of Directors
The Board of Directors is responsible for the preparation and fair presentation of financial statements for the Group that comply with generally accepted accounting practice in
New Zealand.

The Board of Directors' responsibilities arise from the Crown Research Institutes Act 1992.

The Board of Directors is responsible for such internal control as it determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error. The Board of Directors is also responsible for the publication of the financial statements, whether in printed or electronic form.

Responsibilities of the Auditor
We are responsible for expressing an independent opinion on the financial statements and reporting that opinion to you based on our audit. Our responsibility arises from the Public Audit Act 2001.

Independence
When carrying out the audit, we followed the independence requirements of the
Auditor-General, which incorporate the independence requirements of the External Reporting Board.
In addition to the audit, we completed an assurance engagement report on the profit calculation pursuant to the staff profit share scheme. This engagement is compatible with the independence requirements of the Auditor-General.

Other than the audit and the assurance engagement performed, we have no relationship with or interests in the Group.

John Mackey
Audit New Zealand
On behalf of the Auditor-General
Christchurch, New Zealand

Financial Indicators

Financial key performance indicators as required by MBIE (not part of the Audited Financial Statements).

For year ending 30 June:	Actual 2016	Business Plan 2016
Efficiency:		
Operating margin	12.4%	10.4%
Operating margin per FTE	$22,673	$18,499
Risk:		
Quick ratio	1.98	1.33
Interest coverage	336	614
Operating margin volatility	13.1%	12.0%
Forecasting risk	1.1%	-0.7%
Tailored rate of return:		
ROE before investment	8.1%	6.9%
Return on equity (ROE) (based on NPAT)	6.7%	5.0%
Growth/investment:		
Revenue growth	-2.3%	2.6%
Capital renewal	0.7	1.4

Operating margin:
EBITDAF ÷ Revenue, expressed as a percentage. (EBITDAF is EBIT before depreciation, amortisation and fair value adjustments.)

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

Interest coverage:
Interest is the cost of debt and financial leases. Interest cover = EBITDAF ÷ interest. (EBITDAF is EBIT before depreciation, amortisation and fair value adjustments.)

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: net profit after tax.)

Shareholders' funds:
Includes share capital and retained earnings.

Capital renewal:
Capital expenditure / Depreciation expense plus amortisation expense.

Glossary & Guide to Acronyms

ARLUNZ	Agent-based Rural Land Use New Zealand model
B3	Better Border Biosecurity, a multi-partner science collaboration
BusinessNZ	New Zealand's largest advocacy group for enterprise
CEMARS	Certified Emissions Management and Reduction Scheme
CRC	Cooperative Research Centre (Australia)
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
DCD	Dicyandiamide, a nitrification inhibitor
DHB	District Health Board
DOC	Department of Conservation
DNDC	DeNitrification-DeComposition computer simulation model
ECan	Environment Canterbury
E. coli	*Escherichia coli*, a bacterium commonly found in the lower intestine of mammals
ESR	Institute of Environmental Science and Research
Ecosystem services	The 'free' services that healthy ecosystems provide, e.g. clean water, fertile soil, storm water retention, erosion prevention
Environmental limit	The point at which ecosystem services collapse, e.g. the soil's biological community is depleted to the extent that it can no longer replenish nutrients
EMaR	Environmental Monitoring and Reporting
EPA	Environmental Protection Authority
Harakeke	Māori name for New Zealand flax
IPCC	International Panel on Climate Change
Kaitiakitanga	Traditional guardianship of natural resources
KPI	Key Performance Indicator
LCDB	Land Cover Database
LINZ	Land Information New Zealand
LUCAS	Land Use and Carbon Analysis System
LUMASS	Land Use Management Support System
Mātauranga	Traditional cultural knowledge
MBIE	Ministry of Business, Innovation and Employment
MFAT	Ministry of Foreign Affairs and Trade
MfE	Ministry for the Environment
MPI	Ministry for Primary Industries
NES	National Environmental Standard (MfE)
NGO	Non-governmental organisation
NLRC	National Land Resource Centre
NZAGRC	New Zealand Agricultural Greenhouse Gas Research Centre
NZFARM	New Zealand Forest and Agriculture Regional Model
NZLRI	New Zealand Land Resource Inventory
OSPRI	Operational Solutions for Primary Industries, comprised of the TBfree New Zealand and the National Animal Identification and Tracing programmes
RHD	Rabbit haemorrhagic disease
RMA	Resource Management Act
SCION	A Crown research institute
S-map	Digital soil map for New Zealand
SME	small and medium-sized enterprise
TB	Tuberculosis
TPK	Te Puni Kōkiri
UMF	Unique mānuka factor
Vis-NIR	Visible near infrared

Chemical symbols

C	Carbon	CO_2	Carbon dioxide	NH_3	Ammonia
CH_4	Methane	N	Nitrogen	N_2O	Nitrous oxide
				P	Phosphorous

Directory

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Gavan Herlihy MAgSc (Hons)
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Prof. Caroline Saunders BSc (Hons), PhD, ONZM, MInstD
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Katrina Benedetti BSc, MSc (Hons), PGDipIndOrgPsyc	General Manager, People & Communications
Phil Hart BSc, MAgSc (Hons), PhD	General Manager, Development
Peter Millard BSc (Hons), PhD	General Manager, Science
Nigel Thomson BCA, BSc, CA	General Manager, Corporate Services
Fiona Carswell BSc, MSc (Hons), PhD	Chief Scientist

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Science New Zealand

New Zealand's
Crown Research Institutes

Science working for New Zealand

Stan Bellgard
Plant Pathologist
Landcare Research

Landcare Research is proud to be a Crown Research Institute. Together we represent the insight and commitment of 3500 people - using science for a more prosperous, sustainable and innovative New Zealand.

agresearch · ESR · GNS Science · Landcare Research Manaaki Whenua · NIWA Taihoro Nukurangi · Plant & Food Research · SCION

LANDCARE RESEARCH
MANAAKI WHENUA