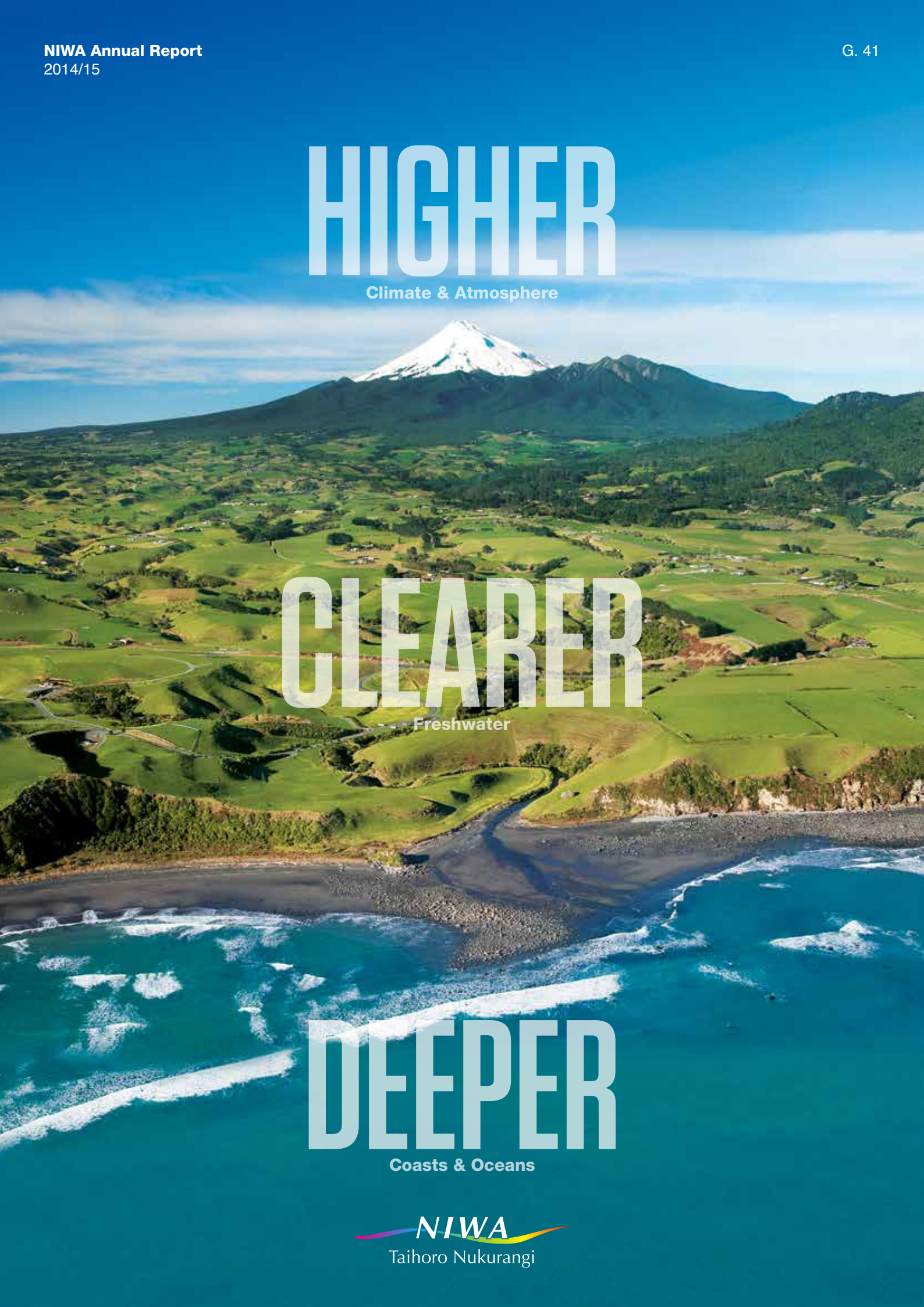
NIWA Annual Report
2014/15

G. 41



Enhancing the benefits of New Zealand's natural resources

HIGHER represents our greater understanding of what's happening in the atmosphere, and the higher precision we're achieving with our environmental forecasting services.

CLEARER represents our ability to provide science to achieve the nation's aspiration for clearer water, and a clearer understanding of our customers' needs, so our science can add value to their activities.

DEEPER represents our ability to reach deeper into our oceans to identify the rich resources of our marine estate, and to guide their sustainable use.

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NIWA
Taihoro Nukurangi

NIWA Annual Report 2014/15

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COLLABORATION, COMMUNICATION AND A CLEAR FOCUS

the keys to another satisfying year

Left

John Morgan
Chief Executive

Right

Chris Mace
Chairman

In late January 2015, NIWA's deepwater research vessel *Tangaroa* sailed out of Wellington Harbour and began a 6-week voyage south to Antarctica. On board this collaborative voyage were scientists from NIWA and the Australian Antarctic Division, along with two students from the Sir Peter Blake Trust Blake NIWA Science Ambassador Programme. Typically, the scientists had planned a multitude of different research programmes.

During this voyage, their research focused on humpback and blue whales to better understand their numbers and distribution, toothfish and their major prey species, and continual sampling of the ocean and the atmosphere with the ultimate aim of improving weather forecasting and better understanding changes in the Southern Ocean and the effect of these changes on the climate.

Back at home, our stakeholders and the public were able to follow every aspect of the voyage – from the weather and sea state and the ground-breaking science to the day-to-day experiences of the scientists, crew and Blake NIWA Science Ambassadors. They were able to do this because our photographer on board *Tangaroa* regularly sent photographs and videos, and the scientists and Ambassadors posted daily blogs and reports of their scientific activities. And back in Wellington our communications team sent out regular media releases with photographs and videos, whilst the prominent news website 'stuff.co.nz' created a microsite, which featured continuously updated video, photo and news coverage of the voyage, as did other major media players – all focused on maximising communication of our science and the benefits it brings.

Using satellite communication technology, and a combination of traditional and social media, we were able to deliver these stories to an information-hungry public within just a few hours of their production. Rarely have we been able to generate such strong interest in our research, from such remote locations, so quickly.


Dave Allen

Collaboration between Antarctica New Zealand, the Australian Antarctic Division and NIWA resulted in this year's hugely successful research voyage to Antarctica.

Collaboration and communication

In many ways, *Tangaroa's* Antarctic expedition symbolised the era of scientific discovery and outreach in which we now work. The extraordinary collaboration and communication that characterised the voyage were themes that underpinned what was another pleasing year for NIWA.

Active collaboration – with other research organisations and with current and prospective customers – played a crucial role in our achievements throughout the year. By way of example, the Antarctic expedition mentioned above was made possible by a partnership between Antarctica New Zealand, the Australian Antarctic Division, and NIWA. It was one of numerous examples of multi-party, multidisciplinary marine, freshwater, and climate and atmospheric research we undertook throughout the year which had measurable and visible benefits for New Zealand.

Informing, inspiring and engaging our stakeholders, including our commercial customers, in new and innovative ways was another of the year's central themes. World-class science has always been at the heart of our success, but, increasingly, the people we work with expect us to communicate our goals and findings, along with the potential implications for both business and society, using language and media which are directly relevant to them, and available instantly.

NIWA's deepwater vessel Tangaroa *on its 10th voyage to Antarctica earlier this year.*


Dave Allen

Making progress with the National Science Challenges

An important aspect of our work during the year was contributing to the development of a number of the government-initiated National Science Challenges in which we have a key role.

The two NIWA-hosted Challenges – *Deep South* and *Sustainable Seas* – progressed well. The *Deep South* contract with the Ministry of Business, Innovation & Employment (MBIE) was negotiated and signed, and the collaboration agreement to guide the management of *Deep South* was drafted and agreed on. The *Sustainable Seas* contract was also negotiated with MBIE and signed, and the collaboration agreement prepared.

However, the longer than expected time it has taken to get the Challenges in which we have a major role underway – *Deep South, Sustainable Seas, Resilience to Nature's Challenges, New Zealand's Biological Heritage* and *Our Land and Water* – put beyond reach the $4.2 million of Challenge-related revenue we planned for in our 2014/15 budget.

Inevitably, the complexity of bringing together the ideas, interests and priorities of multiple stakeholders delayed the establishment of the Challenges. However, there is no lack of effort and goodwill on the part of all involved, and we remain committed to supporting the implementation of the Challenges as effectively as we can.

Pleasing financial, science and health and safety achievements

Alongside the shortfall in budgeted revenue from the Challenges, our performance this year was influenced significantly by the increasingly competitive environment in which we operate.

We witnessed that increased competition across all areas of our work, largely reflecting the constrained expenditure by our central and local government customers. A significant proportion of our customer base demonstrated caution – and understandably so – as factors such as the global economic uncertainty took their toll.

Financial outcomes

Against this backdrop, we were pleased to achieve revenue close to budget at $126.3 million and an operating profit before tax of $8.0 million, well ahead of our budget of $6.5 million. Net profit after tax was $5.8 million, compared with a budget of $4.7 million, with a return on average equity after tax of 5.8%.

Science KPIs

NIWA's 2014/15 Statement of Corporate Intent outlined 64 KPIs for evaluating the achievement of our science strategies spread out over five years. At the year-end, 60 of the science performance measures were achieved in full or were on track, and the remaining 4 had been mostly achieved or were delayed for reasons beyond our control. It has been another satisfying year of science achievement and knowledge transfer.

Health and Safety performance

Given the nature of NIWA's activities, the health and safety of our people and those who work with us remains a key focus for the Board and Executive Team. Following the implementation of *NIWAsafe* – our initiative to reinvigorate our focus on and commitment to safety – it was pleasing to see improvements in several aspects of our health and safety performance during the year.

Marketing and focus

We continued our efforts on the marketing of our research and applied-science services to potential customers, while sharpening our focus on efficiency, productivity and keeping our delivery promises to customers.

We also benefited substantially from close adherence to our organisational mission – *enhancing the economic value and sustainable management of New Zealand's freshwater and marine resources; improving understanding of our climate and the atmosphere; increasing New Zealanders' resilience to weather and climate hazards* – and from a tight focus on our science and organisational strategies.

This year NIWA launched IrriMet, a new product aimed at helping farmers make precise decisions about when to irrigate.

HIGHER – Climate and Atmosphere

Over the next 5 years, we plan to invest another $70 million in climate and atmospheric research to ensure New Zealanders get the best possible forecasts and information about the potential impacts of climate and weather on their lives and livelihoods.

During the year, we released an upgraded version of our forecasting model, and we can now provide specific weather forecasts for locations as little as 1.5km apart – the highest resolution available in New Zealand. This is a very significant advancement. It means not only can we provide a forecast for a suburb or a farm, we can provide a forecast for an individual street or paddock.

This year we developed our internal multimedia capability, which included the construction of a state-of-the-art production studio. This represents a leap forward in our ability to translate complex scientific information, as well as weather and climate forecasts and data, into a language and style which are tailored, meaningful and accessible for our customers and stakeholders.

We used this multimedia capability to produce highly effective weather videos for the National Fieldays at Mystery Creek, which showcased our high-resolution forecasting capabilities to the primary sector. Our broadcast meteorologists also produced videos that tracked the progress of Cyclone Pam as it bore down on New Zealand, and informed fans attending major international cricket and football matches about the weather they would experience at game time. They were posted on our NIWAWeather website.

We expect the use of multimedia communication to increase, due to the increasing importance of video as a medium for knowledge transfer and effective media and stakeholder engagement, and our continuing efforts to ensure our research and applied-science services are communicated as widely as possible, and their benefits are available to all New Zealanders.

CLEARER – Freshwater

Few environmental issues raise the public interest more than the quality, use and management of our precious freshwater resources.

NIWA's science is a key contributor to the National Policy Statement for Freshwater Management, which requires regional councils to establish objectives and set limits for freshwater use. That science tells us that New Zealand's water quality, when compared with that in the rest of the world, is actually very high. There are, however, areas of undoubted concern.

This year we continued to advance our research into riparian strips and wetland systems, which can prevent sediment and pollutants from reaching waterways, help manage farm nutrient losses and – in the case of the innovative, floating wetlands – even remove nutrients from water bodies.

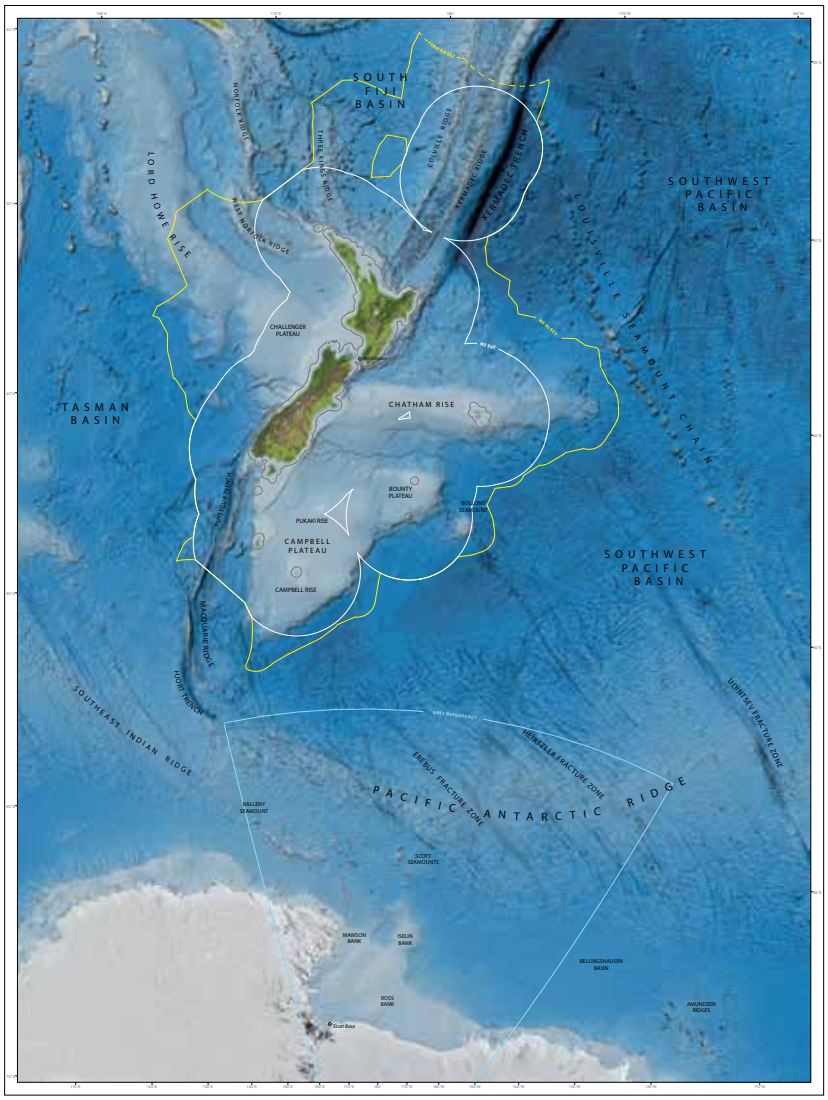
We have also developed and implemented software and hardware for advanced systems which precisely control the delivery of irrigation water, where and when it is needed. Coupled with our high-resolution weather and soil-moisture forecasting capabilities, this technology allows us to help farmers and growers manage their water use effectively.

Water, of course, is also the driving force behind about 60 per cent of New Zealand's electricity production. NIWA provides critical inflow information to the hydroelectricity industry, based on our climate and hydrological monitoring and forecasting, helping generators optimise scheduling and ensure the lights stay on in New Zealand homes and businesses.

DEEPER – Coasts and Oceans

NIWA's team of close to 300 coastal and marine scientists and technicians continued to advance our understanding of New Zealand's large and globally significant marine domain – an essential outcome given our position and role as a maritime nation and the opportunities and responsibilities that presents. If our Territorial Sea, Exclusive Economic Zone, Extended Continental Shelf, the Ross Dependency and the area over which New Zealand has search and rescue responsibilities are all included, that domain accounts for nearly 10 per cent of the world's oceans.

It's not surprising, then, that our marine biodiversity work over the year identified more than 4500 marine animals from over 730 different species. Each year, we describe about 50 marine species that are new to science. We also provide a critical taxonomic service on



NIWA's new chart of New Zealand's marine realm – the most accurate and detailed map yet of the seabed around New Zealand. Our marine realm includes New Zealand's Territorial Sea, the Exclusive Economic Zone, the Extended Continental Shelf, the Ross Dependency and the area over which New Zealand has search and rescue responsibilities – nearly 10% of the world's oceans.

invasive marine species to support the Ministry for Primary Industries' (MPI) biosecurity responsibilities.

As the principal provider of fisheries stock assessment advice to MPI, NIWA has built up some 30 years of information and data. Continuous development of our assessment tools and modeling, and investment in advanced technology, has enabled us to continue to provide the independent, objective research that is critical to inform decision making on the sustainable harvesting of this valuable national asset – our fisheries. Whilst acutely aware of cost pressures, NIWA continues to work with the fishing industry and the regulatory authorities to ensure high quality information is available to assist decision making. This work is one of the priorities in NIWA's Statement of Core Purpose and we must continue to maintain this independent specialist capability for the benefit of the industry and the credibility of our fisheries exports in the international marketplace.

Tangaroa's versatility and value

Late in 2014, we presented *Tangaroa* as the ideal platform from which Geoscience Australia could undertake surveying work in the Browse Basin, in the Indian Ocean off the northern coast of Australia.

Geoscience Australia were generous in their praise of both the vessel and crew, and the data collected during the voyage were valued highly. In operating conditions, which could not have differed more from those experienced in the waters around Antarctica, *Tangaroa* passed yet another test of reliability and versatility in an extremely testing environment, with flying colours.

Tangaroa remains New Zealand's most substantial piece of scientific equipment and, as a consequence of ongoing investment in its capacity, is one of the most sophisticated – a national capability of extraordinary value, particularly in view of the immense natural asset, largely unquantified, that is our marine estate.

Globally significant science

The collaborations that underpinned our achievements this year weren't confined to home soil. Many of the science domains in which we work cross national and geographical boundaries, and our scientists routinely partner with counterparts from research organisations in many different parts of the world. Often our people and facilities are acknowledged for their contribution to the advancement of issues of global significance, and this year was no exception.

In March, a special event was held at NIWA's Atmospheric Research Station at Lauder in Central Otago to recognise the site's certification as a GRUAN (Global Climate Observing System (GCOS) Reference Upper Air Network) measurement site. Lauder, which is complemented by our atmospheric measurement site at Arrival Heights in Antarctica, is now one of only five GRUAN certified sites worldwide, and the first and only site in the southern hemisphere. Lauder's outputs are key to advancing global knowledge about the changing composition of the atmosphere.

In June, an international consortium of users of the UK Met Office's Unified Model, a global weather and climate computer modeling system which underpins a number of our forecasting models and services, appointed NIWA as a core partner. This places NIWA at the governance table of a global forecasting system recognised as one of the world's most powerful, sophisticated and accurate. We will play a key role in the collaboration that sets the direction for development of the Unified Model – a status which recognises our significant contributions to its development over several years, and our commitment to ongoing technical and science support.

NIWA's work to forge effective partnerships in the Pacific also continued apace. Our goals in the region focus very much on knowledge transfer and local capacity building, necessitating the establishment of highly functional partnerships with a range of authorities and service providers across the far-flung Pacific Island nations, as well as with New Zealand's Ministry of Foreign Affairs and Trade's Pacific Division.

Thanks to the expertise, dedication and versatility of our people working in the region, we've been able to help our Pacific neighbours make significant gains this year in areas of critical importance to their lives and livelihoods – in particular, water quality and sanitation, resilience to weather- and climate-related hazards such as tropical cyclones and sea-level rise, and preparedness for tsunami.

NIWA scientist Julie Hall, left, is part of an ongoing focus by NIWA to transfer knowledge and build local capability in Pacific Island nations. Here Julie helps Kiribati environmental health officers assess water quality in South Tarawa.

Dave Allen

Mark Brimblecombe

NIWA is working towards an integrated, national flood-forecasting service to enable authorities to better prepare for the impact of extreme weather events such as the floods which devastated Whanganui in June.

Cross-disciplinary power

This annual report includes discussion of our various capabilities and achievements as discrete outcomes, but our real strengths as an organisation – and perhaps our greatest competitive advantage – are our people and the sheer breadth and variety of the science we undertake across the Freshwater, Coast and Oceans, and Climate and Atmosphere domains, and the fact that we can devise cross-disciplinary solutions to challenges of profound national significance.

NIWA's work serving the primary sector is a good example. We've been able to combine our high-resolution weather and environmental forecasting capabilities, which underpin our online decision-support tools for farmers, with our leading-edge research into riparian strips, wetland filters and treatment ponds, and our advanced systems for precisely controlling the delivery of irrigation water. Together, these capabilities offer the sector a compelling package of interlinked, science-based solutions to improving management of water quality and use – a key national priority. There is much more that we can achieve in this way.

This year, the residents of Dunedin and Whanganui bore the brunt of Nature's fury in the form of devastating floods which wrecked homes, businesses and infrastructure. NIWA is working to enable better preparedness to cope with the impact of such events, by combining a range of our tools into an integrated, national flood-forecasting service.

We can monitor and forecast rainfall across the country to a resolution of 1.5km. Our TopNet flow-prediction model accounts for every step the water takes on its journey from the tree canopy to waterways. TopNet can forecast, hours ahead, how rainfall will change river heights and flow rates. Then, our RiskScape tool can predict where the water will go if the waterways flood. It can also estimate the cost of damage to buildings and businesses in the water's path.

We are moving towards combining these tools in a way which will give national and local authorities more accurate flood forecasts in time to deploy protective measures and move people and assets out of harm's way. We believe there is an urgent need to expedite this work, and we look forward to continuing our discussions with the relevant central and local government agencies to promote the establishment of a national flood-forecasting service.

Chief Executive John Morgan outlines NIWA's capabilities, strategic direction and this year's key science advances at a customer and stakeholder event in Wellington.

Best people, best skills, best outcomes

Our year of solid achievement is, as always, thanks entirely to the inspiration, resourcefulness and commitment of NIWA people – at all levels. The Board and Executive Team are extremely proud of the unwavering effort put in by our staff across all of our science and support functions. NIWA people, in turn, can be enormously proud of the direct and profound contribution they are making to the scientific advancement of New Zealand.

Attracting and retaining the best scientists, technicians and support staff is one of the key platforms of our organisational strategy. We place great importance on creating opportunities for NIWA people to fulfil their career goals, and we encourage them to grow as recognised experts in their field, as leaders, communicators, and productive, responsive, customer-focused professionals.

In this report we acknowledge the achievements of a number of our people who were recognised at the 2015 NIWA Excellence Awards Dinner. We also note the external recognition of the individual achievements of Dr Rob Murdoch, who was awarded the Royal Society's Thompson Medal during the year, and Geoffroy Lamarche, who was awarded the French Government's Chevalier Medal.

We would like to record our special thanks to Craig Ellison, a member of the NIWA Board for the last eight years, who retired from the Board on 30 June 2015. Craig's contribution has been substantial, and his influence is evident in many aspects of NIWA's strategic direction today. We welcome Mike Pohio to the Board as Craig's successor, and look forward to the addition of his skills and experience to the governance table.

One of the year's most memorable events for NIWA was a function we held in Wellington in June to share information about NIWA's capabilities and strategic direction with a selection of NIWA stakeholders. The occasion was very well received, with many guests remarking on the extraordinary nature and importance of our work to the future of New Zealand's economic, environmental and social prosperity.

The event reinforced, once again, the value of effective collaboration and innovative communication – coupled with excellent science and close attention to customer service, our central themes of the year.

We are confident those themes will stand us in good stead again over the next 12 months, as we strive to enhance our position as this nation's leading provider of Freshwater, Coast and Oceans, and Climate and Atmospheric science – for the benefit of all New Zealanders.

Chris Mace
Chairman

John Morgan
Chief Executive

FINANCIAL SUMMARY

A pleasing financial performance with revenue of $126 million and operating profit before tax of $8 million

Group actual performance versus Statement of Corporate Intent (SCI)

For the year ended 30 June 2015

in thousands of New Zealand dollars	Actual 2015 $	SCI 2015 $	Actual 2014 $
Operating revenue and other gains	126,259	126,604	123,539
– Research	64,075	69,081	65,176
– Applied science	62,115	57,523	58,221
– Other income	69	–	142
Operating expenses, depreciation, and amortisation	118,649	120,192	116,421
Operating profit before tax	8,005	6,540	7,324
Net profit after tax	5,755	4,706	5,278
Average total assets	136,754	136,657	137,003
Average shareholders' funds	104,505	101,942	102,022
Capital expenditure	15,652	12,541	10,852
Profitability			
Operating profit margin (%) (EBITDAF/revenue)	17.4	15.7	16.2
Adjusted return on average equity after tax (%) (net surplus/adjusted average equity)	7.0	6.0	6.7
Return on average equity after tax (%) (net surplus/average equity)	5.5	4.6	5.2
Return on assets (%) (EBIT/average total assets)	5.6	4.7	5.2
Profit volatility (%) (non-adjusted ROE)	10.1	6.5	14.0
Forecasting risk (%)	(0.3)	2.0	(0.2)
Liquidity and efficiency			
Current ratio	1.5	1.2	1.4
Quick ratio	2.1	1.5	1.9
Financial leverage			
Debt to average equity (%)	–	–	–
Gearing (%)	–	–	–
Proprietorship (%) (average shareholders' funds/total assets)	76	75	74

The 'adjusted return on average equity' uses a valuation basis comparable to that used by other Crown Research Institutes. This valuation basis arose from the transition to New Zealand equivalents to International Financial Reporting Standards in 2006/07 and reverses the effect of the revaluation of certain land and buildings.

OVERVIEW OF GROUP FINANCIAL PERFORMANCE

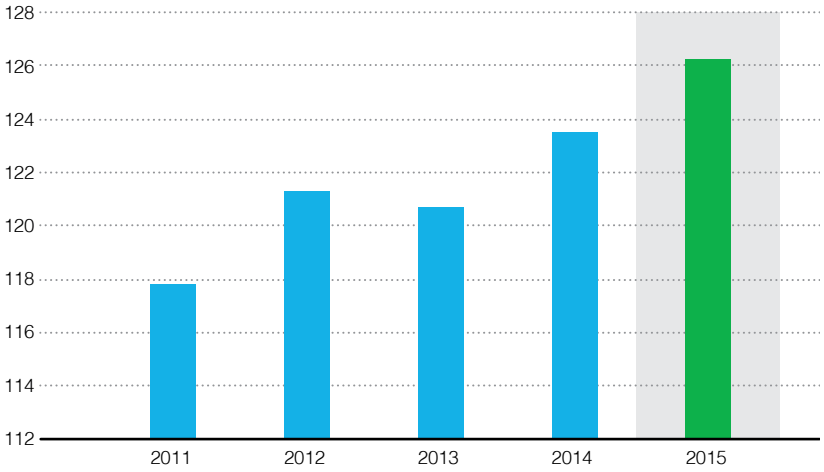
This year continued the trend of recent years, with material year-on-year improvements in all key financial measures.

Revenue

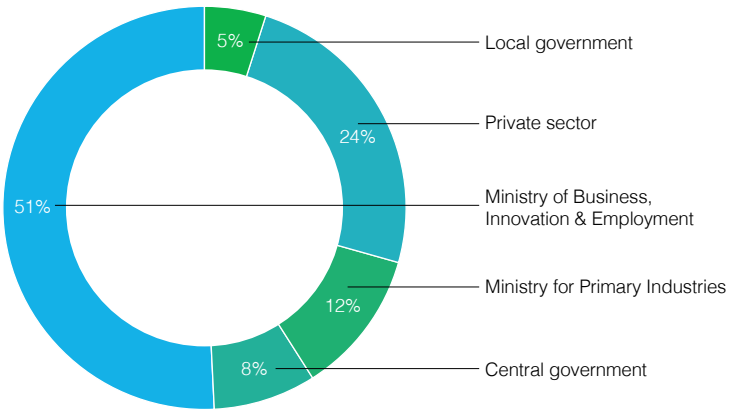
NIWA delivered revenue of $126.3 million this year, reflecting year-on-year growth of $2.7 million and coming within $350k (less than 0.3%) of achieving a challenging SCI budget target. This represents a considerable achievement in the current market environment, particularly given that continuing delays with the establishment of the National Science Challenges put the bulk of an expected (and budgeted) $4.2 million of Challenge revenue beyond reach. This demonstrates the continuing relevance of NIWA's research and applied science services to its customers as well as the Company's agility in being able to respond to changing customer needs.

Year-on-year, the share of NIWA's revenue arising from transactions with its key central government clients of the Ministry of Business, Innovation & Employment, and the Ministry for Primary Industries, fell by 5% to 63%. Conversely, the share of the Company's revenue driven by sales to the private sector (including to overseas clients) increased by 5% to 24%. Much of this was driven by vessel charter sales delivered through the Company's subsidiary, NIWA Vessel Management Limited, the operator of the research vessels *Tangaroa*, *Kaharoa* and *Ikatere*.

Operating revenue and other gains ($) in millions



Revenue by source

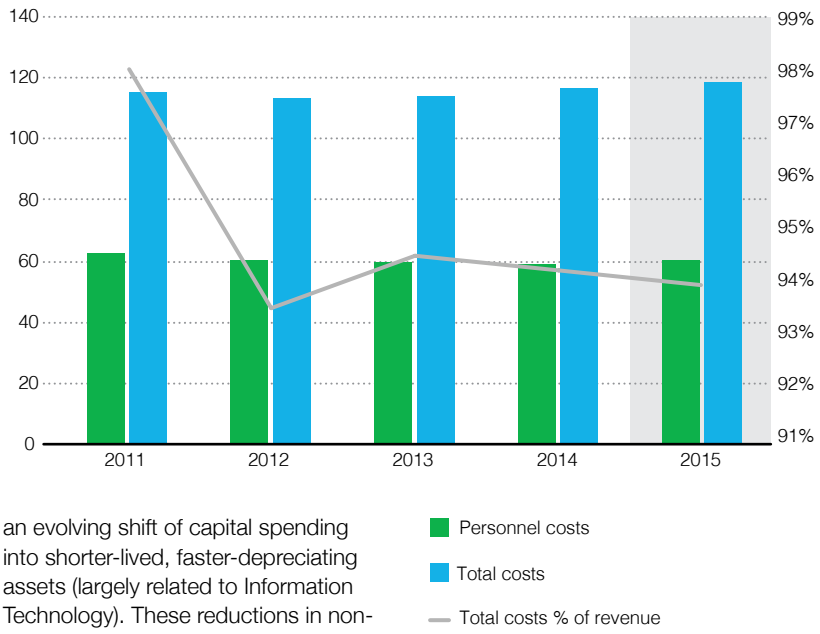


Expenditure

The Company continued its relentless focus on restraining its costs and maximising its efficiency, without compromising on its alignment with the current and future needs of our national, regional and global clients and collaborators. However, NIWA recognises that the expertise and commitment of its people are key to the Company's success, and that is reflected in our continuing strategy to remunerate our staff at or above market rates. Employee benefits expense increased this year to $60.5 million (2014: $59.1 million), reflecting not only carefully considered increases to staff remuneration, but also recruitment actions to fill vacant positions, supporting the Company's continued revenue growth and future capability.

This increase was partly offset by a reduction of $0.8 million in other expenses. This demonstrates the Company's focus on cost control and efficiency, because this reduction is net of an increase in depreciation and amortisation of $1.4 million, driven by an evolving shift of capital spending into shorter-lived, faster-depreciating assets (largely related to Information Technology). These reductions in non-personnel costs, combined with the year-on-year revenue increase, resulted in expenses falling as a proportion of revenue compared with last year.

Expenditure ($) in millions

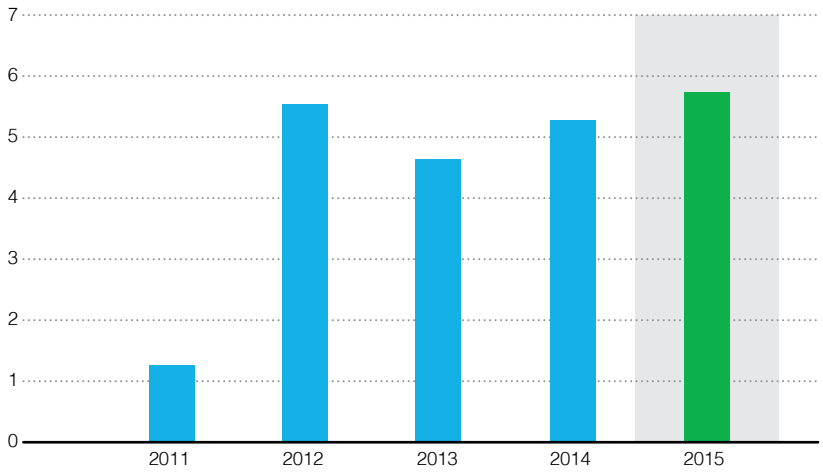


Profitability

The result of combining revenue growth with cost control was that NIWA delivered EBITDA and NPAT outcomes that were significantly improved on last year's result and SCI budget. EBITDA of $22.0 million was $2.0 million better than the prior year and $2.1 million better than the budget objective. NPAT of $5.8 million was $0.5 million better than the prior year and $1.1 million better than budget.

NIWA's fundamental financial performance metric is adjusted return on equity, which enables comparison between CRIs on an equivalent basis. The Company delivered an adjusted ROE of 7.0% this year, up from 6.7% last year and 1.0% better than the budget objective.

Net profit after tax ($) in millions



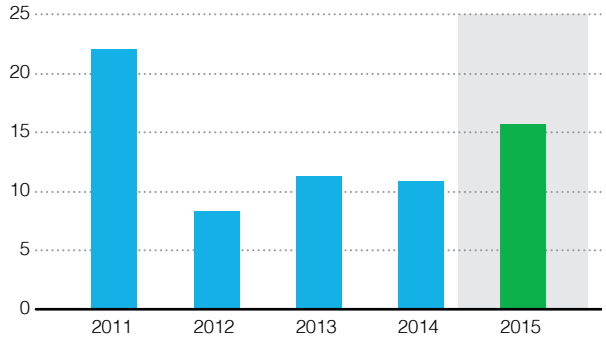
CAPITAL MANAGEMENT AND CASH

Capital spending

The following table summarises NIWA's capital expenditure this year and last year:

in millions of New Zealand dollars	2015	2014	Change
Land, buildings & improvements	5.294	1.787	3.507
Equipment	5.553	4.814	0.739
IT equipment	2.815	2.225	0.590
Vessel equipment	1.501	1.235	0.266
Other	0.489	0.791	(0.309)
Total capital spending	15.652	10.852	4.800

Capital Expenditure ($) in millions



Total capital expenditure was $15.7 million during the year, up from $10.9 million during the prior year. The increase is explained primarily by the purchase of land and buildings at NIWA's Northland Marine Research Centre, which was committed, but not settled, during the prior year.

Cash flows

The following table summarises NIWA's cash flows this year and last year.

in millions of New Zealand dollars	2015	2014	Change
Net cash flows from operating activities	16.736	21.770	(5.034)
Net cash flows from investing activities	(15.574)	(10.536)	(5.038)
Net cash flows from financing activities	(4.000)	(2.395)	(1.605)
Net increase/(decrease) in cash and cash equivalents	(2.838)	8.839	(11.677)

Net cash flows from operating activities

Net cash inflows from operating activities decreased by $5.0 million to $16.7 million in 2015. The most significant drivers of this year-on-year change were:

- an increase of $5.0 million in payments to suppliers and employees, driven by higher operating expenses combined with a reduction in the year-end employee salary accrual; and
- an increase in tax payments in 2015 of $2.8 million, with 2014 payments being reduced due to refunds arising from prior years combined with lower provisional tax payments.

These were partly offset by:

- a net increase of $2.5m in cash received from customers, driven by higher operating revenues, partly offset by a lower reduction in the receivables balance than was experienced last year.

Net cash flows from investing activities

Net cash outflows from investing activities increased by $5.0 million to $15.6 million. The most significant driver of this year-on-year variance was:

- an increase in spending on land and buildings of $3.8 million, mainly explained by the purchase of NIWA's Northland Marine Research Centre in Bream Bay.

Net cash flows from financing activities

Net cash outflows from financing activities increased by $1.6 million, driven by:

- dividends paid to the Crown increasing by $2.0 million to $4.0 million;

These were partly offset by:

- the non-repeat of a prior year repayment of $0.4 million in respect of a minority shareholder loan to Unidata Pty Limited.

The Company's most significant investments during the year included the following:

$4.3m

Land and buildings at NIWA's Northland Marine Research Centre at Bream Bay

Purchase of the site underscores exciting development opportunities for NIWA and the Northland region for marine research in general and aquaculture in particular.

$544k

An extension to NIWA's climate monitoring network

This initiative supports NIWA's continuing efforts to further improve the accuracy of its weather and climate forecasting capability, which in turn supports the delivery of its strategic initiative of producing environmental forecasts tailored to weather/climate-dependent sectors and customers.

$350k

Ocean glider

Ocean gliders have revolutionised the way ocean observations are made. These autonomous underwater vehicles can collect oceanographic data, such as temperature, salinity, oxygen and fluorescence, at higher spatial and temporal resolutions than those traditionally collected by research vessels, and at a fraction of the cost of vessel time.

$336k

Kongsberg 3002 shallow water multibeam echosounder

This project was to replace an existing system with the latest technology for high resolution mapping of the depth and seabed type of coastal and harbour waters. This will ensure that NIWA's capability remains state-of-the-art, ensuring that the Company is well positioned to deliver to its customers' requirements.

Capital structure and liquidity

Shareholders' equity at 30 June 2015 was $105.4 million, which was $3.1 million higher than the level forecast in the SCI budget (2014: $103.6 million). Total assets at year end were $135.2 million (2014: $138.3 million). As at 30 June 2015, the Company's net debt balance was nil, equal to the prior year-end balance.

NIWA's liquidity is mainly provided by operating cash flows. In addition, the Company has access to financing facilities of $10.5 million provided by its bank, although this facility was not required to be called upon during the year.

Dividends

As foreshadowed in the Company's 2015/16 SCI, the Directors of NIWA have decided not to declare a dividend in respect of the 2015 year. This is in light of a series of significant capital investments which will be required to maintain and build the Company's capability and financial sustainability for the future. These investments include renewing NIWA's high performance computing capability; renovating or replacing the physical infrastructure and facilities at three of the Company's main sites; and continuing development at the Northland Marine Research Centre.

CLIMATE & ATMOSPHERE

New Zealand's pre-eminent provider of atmospheric and climate science

- Improving our understanding of the changing climate to enable adaptation to its impacts
- Contributing to global understanding of atmospheric composition and dynamics
- Improving forecasting to reduce the impact of weather- and climate-related hazards
- Producing environmental forecasts tailored to weather-dependent sectors and customers

NIWA employs New Zealand's largest team of scientists, technicians and support staff dedicated to research and applied-science services in weather and climate and associated hazards.

NIWA's experts utilise world-class data gathering, management and processing facilities, as well as leading-edge communications technology, to translate their science into precise, meaningful and timely weather and climate information, benefitting a wide range of end users in many sectors. NIWA's goal is to enhance knowledge and apply science in ways that inform operational and risk-management decisions made by businesspeople, policymakers and hazard and environmental managers in New Zealand and the South-West Pacific. A key focus is to identify the drivers and consequences of climate change, so that communities can prepare and adapt.

NIWA also participates in extensive global collaborations, which enrich New Zealand's science and provide opportunities for adding greater benefit.

NIWA's climate, atmosphere and weather science includes:

- Observing, analysing and modelling the atmosphere and climate of the New Zealand region
- Determining the role of oceans in influencing New Zealand's climate
- Predicting the effects of climate change and variability on New Zealand and the South-West Pacific
- Determining the impacts of air pollutants on human health, and evaluating mitigation options
- Predicting and evaluating risks, impacts and potential losses from weather-related hazards
- Developing and delivering operational weather and weather-impact forecast models

Dave Allen

Resources

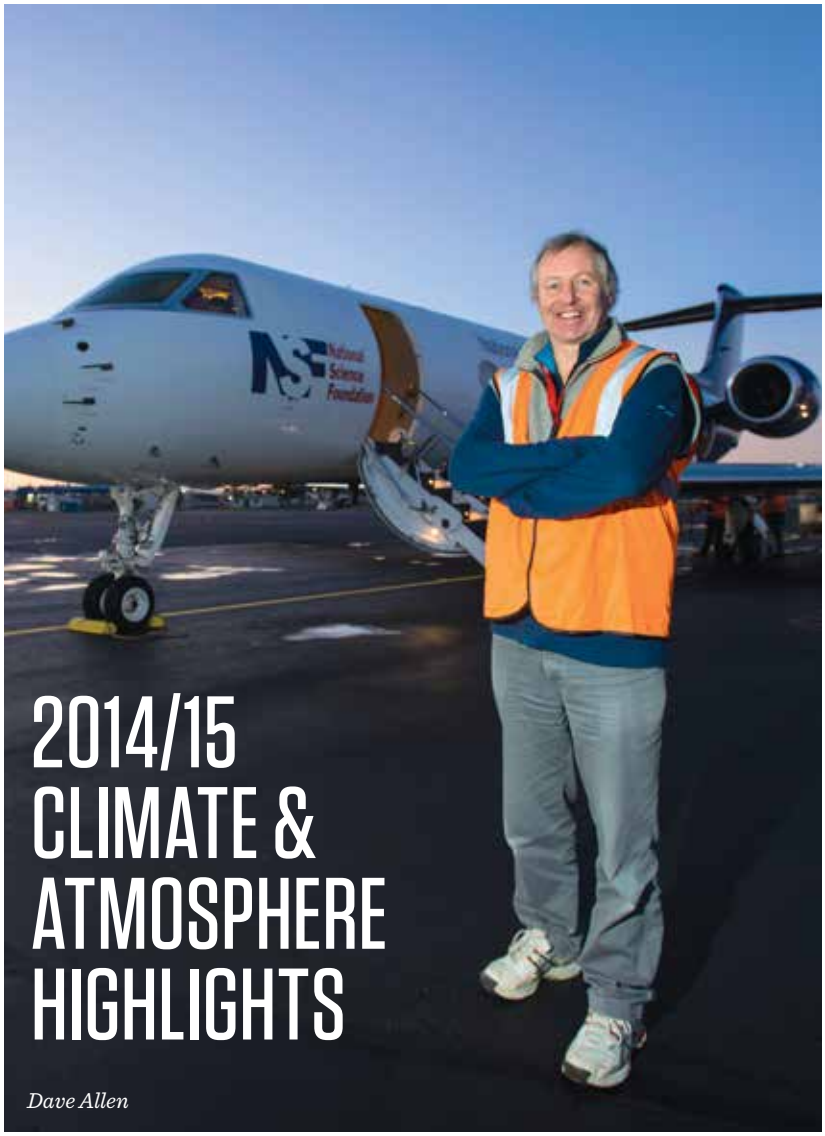
- Approximately 300 science, technical and support staff, working nationwide and collaboratively with other providers and end users across the South-West Pacific and further afield.

Key assets

- The **National Climate Database**, which holds decades' worth of quality-assured climate information from approximately 7500 monitoring stations around New Zealand, the South-West Pacific and Antarctica. Some records date back to the 1850s.
- A **national monitoring network,** comprising 200 NIWA stations and supplemented by many more operated by local and central government agencies and other parties, which take regular climate readings day and night and transmit them direct to the National Climate Database.
- A **High Performance Computing Facility,** or 'supercomputer', which runs sophisticated weather, climate and environmental forecasting models using data from the National Climate Database and other sources. The models produce precise, highly localised forecasts which are deployed to a wide range of end users to support operational and risk-management decisions.
- A fully equipped **digital media studio**, enabling the communication of weather, climate and other science information in innovative, compelling and timely ways.

Investment

- **$30 million annually** for research and applied-science services.
- An additional **$70 million over the next five years** to enhance the quality and reach of our weather and climate research.



Dave Allen

International collaboration runs deep

In July 2014, climate scientists from around the world gathered at locations across the South Island and in Wellington for 'Deepwave' (Deep Propagating Gravity Wave Experiment), a study aimed at better understanding how gravity waves and – which form when strong winds strike a large obstacle such as a mountain range – evolve and can be predicted. Gravity waves are extremely important because they transfer momentum and energy in the atmosphere, affecting the weather as a result.

Deepwave was led by the National Center for Atmospheric Research in the United States and the German Aerospace Centre, and funded by the US National Science Foundation. NIWA climate scientists were able to bring crucial local expertise and context to the international study, in which two research aircraft carrying highly specialised equipment made about 20 flights into the high atmosphere over a 6-week period, when conditions were suitable for data collection.

Meteorologist Richard Turner was part of an international team studying gravity waves in the South Island.

Award-winning engagement with the primary sector

At the Mystery Creek National Fieldays in June 2015, NIWA introduced 'IrriMet', a brand new online subscription service that helps farmers decide when, and when not, to irrigate or apply fertiliser. IrriMet combines local measurements of weather and soil moisture with NIWA's high-resolution weather forecasts to deliver a precise prediction of irrigation need, over the next 6 days, direct to farmers' computers. IrriMet also helps farmers determine when conditions are suitable for applying fertiliser and when the risk of leaching or runoff is high – simultaneously improving their productivity and reducing their environmental impact.

Following the highly successful launch of IrriMet at Fieldays, which saw NIWA's exhibit win the 'Best Indoor Agribusiness Site' award from event organisers, NIWA is working with 50 farmers to gain feedback on the product before it is refined and then officially launched to market.

Chris Hillock

Ocean scientists lift climate knowledge

Automated instruments capable of measuring the properties of the ocean near and far are contributing vital data to the quest for knowledge about the global climate and climate change.

In May 2015, NIWA launched its buoyancy-driven Slocum ocean-monitoring glider, which is deployed in shallow water from NIWA's research vessels to measure temperature, salinity, pressure, oxygen, fluorescence, light and turbidity.

Unlike powered submarines, the glider moves by changing its buoyancy to glide up or down in the ocean. Wings on the glider convert vertical displacement into horizontal motion, resulting in a vertical saw-tooth dive pattern down to about 200m.

Meanwhile, NIWA continued its active contribution to the global Argo programme. Argo floats are automated devices deployed in the open ocean that periodically descend and ascend through the top 2000m of water, taking measurements of temperature, salinity and velocity as they go. They transmit their data via satellite when they reach the surface, before commencing a new cycle of measurement. NIWA has deployed most of the floats located in the South Pacific Ocean.

Data from these devices is helping climate scientists better understand the processes of energy exchange between atmosphere and ocean, as well as the impacts of climate change on the top levels of the ocean. An analysis of Argo data completed during the year by an international team, including NIWA, found the temperature of the world's oceans increased steadily between 2006 and 2013.

Dave Allen

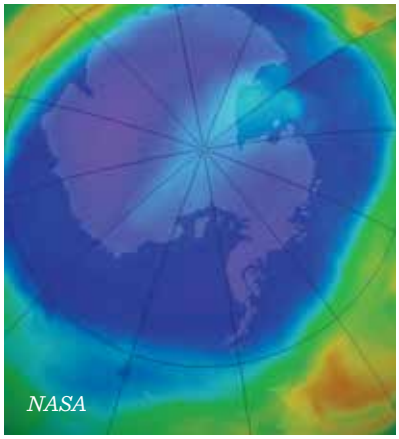
Petr Horálek

Globally significant atmospheric science

In March 2015, a special event was held at NIWA's Lauder Atmospheric Research Station in Central Otago to recognise the site's certification as a GRUAN (Global Climate Observing System (GCOS) Reference Upper Air Network) measurement site. Lauder is now one of only five certified sites worldwide, and the first and only certified site in the southern hemisphere.

GRUAN certification recognises the quality and longevity of the climate and ozone monitoring and analysis done at Lauder, using weekly radiosonde soundings and measurements from associated ground-based equipment. Lauder's outputs are key to advancing global knowledge about the changing composition of the atmosphere.

Aurora Australis at NIWA's Atmospheric Research Station at Lauder.


NASA

Antarctica hosts crucial NIWA eye on the sky

Measurements of ozone and other atmospheric constituents made by NIWA at its GRUAN-certified Lauder Atmospheric Research Station in Central Otago are complemented by data from an ozone spectrophotometer at Arrival Heights, near Scott Base in Antarctica. Both locations offer near-pristine conditions for the observation of atmospheric composition and the monitoring of changes taking place over time.

NIWA's work at Arrival Heights aims to improve understanding of two large-scale science issues: the chemistry that produces the ozone hole, and the sources and sinks of gases and aerosols responsible for radiative heating of the atmosphere – leading to climate change. To study these issues, NIWA measures levels of ozone and a range of other trace gases using a variety of techniques.

New-generation air-quality sensors developed

NIWA air-quality scientists made significant advancements during the year on new equipment and methods for testing air quality in New Zealand's towns and cities. Their aim is to enable communities to observe, understand and control their local air quality in a much more direct – and cheaper – way than previously possible.

Work centred on development of a low-cost dust-sensing package called ODIN (Outdoor Dust Information Node), suitable for easy and secure installation in urban areas. Temperature-sensing units were also developed for installation in residences, along with an online survey for householders, to enable scientists to determine when woodburners are being used and how much of an impact they are having on local air quality at different times of the day during winter.

A trial of the package, using volunteers from the town of Rangiora in North Canterbury, is now under way.


Dave Allen

Environmental monitoring technician Sally Gray uses a helikite in Rangiora to gather weather data for use in air quality assessment.

Drought 'hotspot watch' a vital service

Last summer, for the second time in three years, large areas of the country experienced abnormally low rainfall, placing many water-dependent businesses – particularly in the primary sector – on high alert.

As the summer progressed and conditions became increasingly dry, NIWA reinstated its weekly 'hotspot watch', an advisory sent to New Zealand media providing soil moisture and precipitation maps and commentary for the country, to help assess whether extremely dry conditions were imminent. The information was reproduced widely in print and online, helping farmers and other businesses plan ahead and mitigate risk until significant rain arrived.

Angela Hunt surveys a dry dam in the Wairarapa.

Dave Allen

Using people power to advance climate change research

NIWA is leading New Zealand's contribution to the global 'Weather@home' project, which pools spare computing capacity donated by thousands of volunteers to run state-of-the-art regional climate models. Outputs from those models give climate scientists greatly enhanced insight into how and why climate extremes, such as heavy rainfall and droughts, are changing over New Zealand now and into the future.

Collectively, the volunteers produce an impressive force of computing power – greater than the world's fastest supercomputer – which is needed to run the models a sufficient number of times to accurately capture changes in extreme events. This gives scientists the statistical backing they need to be able to predict the likely impacts of a changing climate – and pass that information on to authorities tasked with helping communities prepare and adapt.

Early in 2015, the Weather@home project launched a specific experiment to investigate last winter's floods in Northland, when five days of extremely heavy rain caused severe damage. When model runs of actual conditions were compared with those that simulate how things might have been without human influence on the climate, there was a discernible change in the risk of such events. Human influence has made them more likely.

Weather forecasts – precise, local and relevant

In 2014, NIWA released an upgraded version of its New Zealand Convective Scale Model (NZCSM), a weather forecasting model that runs on NIWA's High Performance Computing Facility and automatically generates discrete forecasts for locations as little as 1.5km apart. This is the highest resolution available in New Zealand.

This is an extremely significant advancement. It means weather forecasts can be generated at the scale of individual suburban streets, sports grounds, or farm paddocks. The model accounts for the influence of local topographical features such as hills, valleys and lakes, greatly enhancing the accuracy and benefit of weather forecasts for end users such as farmers, orchardists and rural firefighters.

NIWA is simultaneously investing in the installation of new climate monitoring stations around New Zealand – particularly where there are gaps in the network. These stations provide real-time weather observations for end users, and are also used to verify and, where necessary, adjust the outputs of the NZCSM to ensure future forecasts are as precise as possible.

FRESHWATER

Supporting the sustainable management of our precious freshwater resources

- Improving our understanding of New Zealand's freshwater quantity and quality
- Maximising sustainable use of New Zealand's water resources for economic benefit
- Supporting the implementation of the Government's freshwater reforms

NIWA's freshwater and estuarine scientists conduct research and deliver applied-science services focused on the water cycle, the consequences of water use and allocation, water quality, the impacts of catchment land use, pollutant mitigation, invading weeds and pest fish and the restoration of ecosystem health.

They use the data and knowledge they acquire to design models and tools that help a wide range of New Zealanders better manage their interactions with freshwater supplies, maintain or improve water quality, and protect downstream estuarine systems. NIWA scientists work alongside central, regional and local government, other science providers, iwi groups, industry sectors and commercial operators to achieve this goal.

NIWA's freshwater and estuarine science includes:

- Predicting the dynamics of water availability and the ecosystem limits to allocation
- Understanding the interactions between surface water and groundwater, including the pathways for transfer of contaminants
- Identifying threats from introduced aquatic plants and animals and developing tools to mitigate their impact
- Developing techniques to enhance ecosystem health in response to contaminants and habitat modification
- Developing improved operational tools to forecast floods

Lake Wakatipu, Queenstown.

Resources

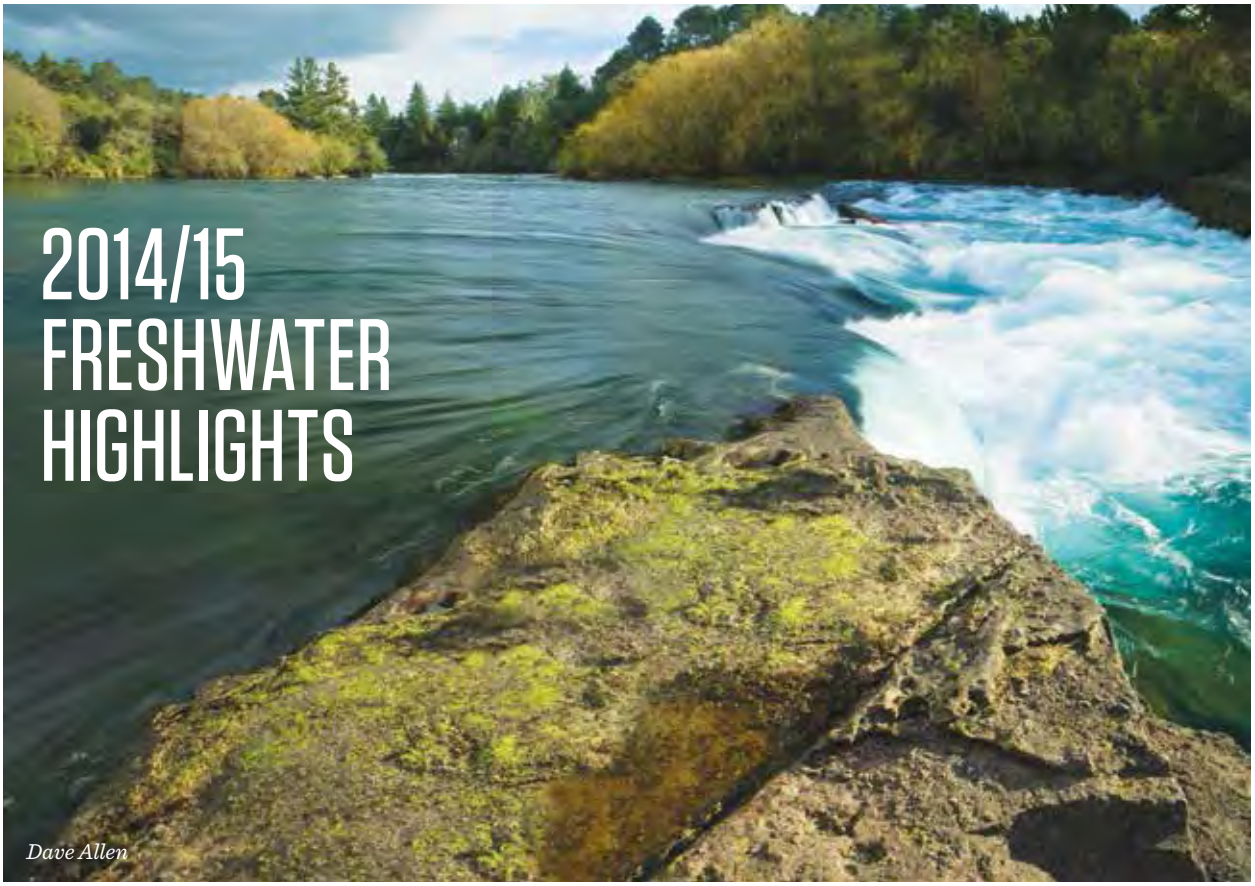
- Approximately 350 science, technical and support staff, working nationwide and collaboratively with other providers and a wide range of freshwater users.

Key assets

- A **nationwide network of hydrological stations**.
- The **Snow and Ice Monitoring Network**, which measures the quantity of freshwater stored in alpine areas as snow and ice.
- The **National River Water Quality Network**, which provides reliable scientific information on physical, chemical, and biological characteristics of 77 sites on 35 rivers throughout the country.
- A wide range of **purpose-built tools and models**, such as WAIORA (Water Allocation Impacts on River Attributes), TopNet (a national stream-flow model), CLUES (Catchment Land Use for Environmental Sustainability) and C-CALM (Catchment Contaminants Load Model), which support planning, ecosystem management, environmental assessment and consent applications.
- Specialist laboratories and analytical equipment.

Investment

- Approximately **$40 million annually** for research and applied-science services.
- An additional **$60 million over the next five years** on research and the transfer of knowledge to government and industry.



Dave Allen

Establishing benchmarks for managing freshwater health

On 1 August 2014, the National Policy Statement for Freshwater Management 2014 (NPS-FM) came into effect. It details responsibility for managing the quality and availability of our freshwater resources, and makes it mandatory for councils to set objectives and limits on water use, guided by a new National Objectives Framework (NOF).

The NOF specifies freshwater 'attributes', or measurable parameters, that need to be managed by councils to ensure freshwater ecosystems in their region are protected. NIWA's science has been fundamental to the population of 'attribute states' for the initial suite of NOF attributes that establish the benchmarks for overall freshwater ecosystem health. We continue to work with the Ministry for the Environment (MfE) to further develop the NOF attributes that define ecosystem health. Two of these, as examples, are fine sediment and dissolved oxygen.

Fine sediment is a key contaminant stressor of many of New Zealand's freshwater ecosystems. As a first step towards developing objectives for the fine sediment attribute, MfE and the Ministry for Primary Industries (MPI) commissioned NIWA to assess the effects of fine sediment on ecosystem health, from freshwater to the estuary at the outlet of the catchment. Whangarei Harbour and its catchment were chosen for the study. The work included a review of the numerical thresholds that determine sediment-related environmental states, and the methods, tools and techniques that relate catchment loads to sediment-related environmental state variables.

NIWA continues to work with MfE on a plan for further research needed to implement the sediment attributes into the NOF.

The concentration of dissolved oxygen (DO) in water is another critical component affecting the life-supporting capacity of a river system. MfE is considering whether the current DO attribute in the NOF should be extended to apply everywhere, including from diffuse sources, rather than just downstream of point sources. NIWA undertook the first stage of the project, determining whether there is sufficient continuous data on dissolved oxygen to assess the current state of the attribute on a national scale.

Scientists at NIWA continue to play a role in expert panels and in the Science Review Panel for the NOF.

Northland sediment study a first

NIWA is undertaking a multifaceted study, commissioned by the Ministry for Primary Industries, to assess the cost to manage, under the Government's National Policy Statement for Freshwater Management (NPS-FM), sediment and *E. coli* levels across a Northland catchment which includes an estuary at the base of the freshwater drainage network.

NIWA's research is the first formal analysis that points to the difficulties of including sediments in the NPS-FM, and provides an excellent synthesis of information that will be widely used. The study also incorporated an analysis of the sediment budget of Whangarei Harbour, which relates catchment sediment runoff and the mass of marine sediments transported by waves and currents to estuary sedimentation rates. This will form a template for future studies in other regions.

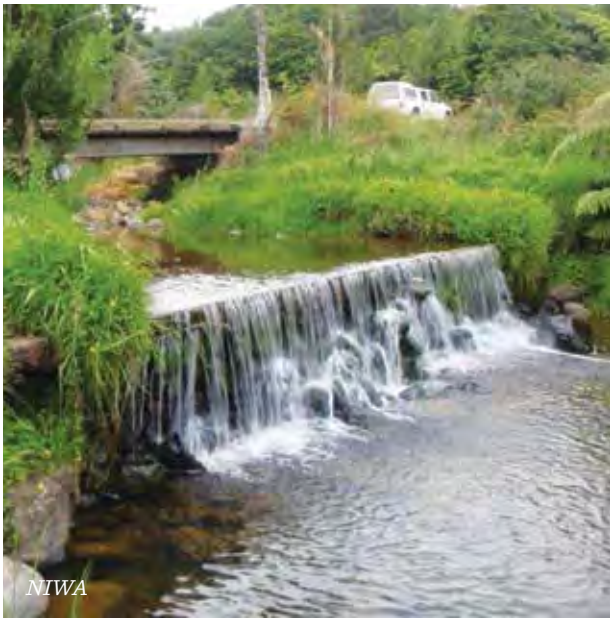
Crispin Middleton

Chris McLennan

Supporting resilient urban futures

NIWA is leading the development of a decision-support system for assessing the effects of urban developments and activities on receiving waterbodies. In the current phase of research, NIWA is investigating how the system can be extended to provide an assessment of the resilience of waterbody ecosystems for ongoing use by communities for activities such as fishing, shellfish collection and recreation – known collectively as ecosystem services.

NIWA and research partner Cawthron Institute have found that information provided by community members on their level of satisfaction with ecosystem services – measured in terms of the quality of their experiences – is helping the development of new methods to assess urban waterbody ecosystem resilience.


NIWA

New advisory group seeks solutions to fish migration barriers

Collaboration between NIWA and the Department of Conservation has led to the formation of the National Fish Passage Advisory Group, which will lead the development of national resources to enhance the management of fish passage in New Zealand.

Barriers to fish migration have a significant impact on freshwater biodiversity, and the group will ensure that strategies for reconnecting waterways are more coordinated.

The group brings together engineers and ecologists from a range of sectors across New Zealand, and NIWA is playing a central role in coordinating its work.

Testing farm runoff water treatment at Waituna

NIWA is working with the Department of Conservation, the Fonterra Living Water Partnership and DairyNZ to jointly fund a trial of a passive woodchip filter designed to reduce nitrogen losses in water from farm tile drains. The trial is taking place on a farm in Waituna, Southland.

A second trial will test the performance of a passive phosphorus filter.

These systems will be tested over the next year, with the aim of guiding development of targeted tools to greatly reduce diffuse loads of nitrogen and phosphorus from farmland to sensitive freshwater environments.

Dave Allen

Glass eel – about 6cm long.

Nelson Boustead

Supporting sustainability of a treasured freshwater delicacy

NIWA's science is helping to answer critical questions about the sustainability of glass eel harvesting in New Zealand.

Tuna (freshwater eels) are a highly valued customary, recreational and commercial species for Māori. Overseas, wild-caught glass eels (juveniles about 6cm long) are used to supply the eel aquaculture industry, and in New Zealand there is a desire amongst iwi and Māori organisations seeking to participate in aquaculture to ensure that glass eel harvesting does not lead to a decline in wild stocks – as has occurred in many other countries.

A three-year project, funded by the Ministry for Primary Industries, Rangitāne North Island (RNI) and Aotearoa Fisheries Ltd, and led by Te Ohu Tiaki o Rangitāne Te Ika a Maui Trust, is focused on developing critical biological reference points to underpin the sustainable development of an eel fishery in the RNI rohe (tribal area). The goal is to improve knowledge about glass eel recruitment and mortality between the glass eel and elver life stages of shortfin eels (*Anguilla australis*).

The project, which finishes in 2016, is the first study undertaken in New Zealand that will attempt to quantify the impact of glass eel harvesting on juvenile eel populations. The approaches being developed and demonstrated are specific to the RNI rohe, but they aim to be transferrable to other locations within New Zealand for the benefit of other stakeholders.

Mapping aids Northland lake management and protection

NIWA and the Northland Regional Council are undertaking hydro-acoustic lakebed surveys of 25 of Northland's unique dune lakes, to aid their ongoing management and protection.

The surveys provide maps of bathymetry information, and measurements of the distribution of submerged vegetation and the relative hardness of lakebed sediments. The volume and depth of the lakes are also recorded.

The North Island's west coast is one of the few places in the world where dune lakes are found, and Northland is notable for the number and diversity of these unique lakes. Many are in pristine condition because they are so isolated and difficult to access.

Investigating river health

NIWA is investigating nutrient attenuation in gravel-bed rivers in collaboration with Cawthron Institute. Monitoring equipment is measuring stream ecosystem metabolism along the Tukituki River. The study is using metabolism as an indicator of ecological stress in response to nutrient enrichment of the river, and as a driver or predictor of nutrient uptake rate under varying conditions of flow and temperature. The work is showing that ecosystem respiration is a key driver of instream phosphorus uptake, whereas ecosystem primary production is a key driver of instream nitrogen uptake.

COASTS & OCEANS

Understanding, caring for and maximising the benefits of our marine estate

- Improving our understanding of New Zealand's marine environment to inform decisions about its management
- Maximising sustainable use of New Zealand's marine resources for economic benefit
- Developing new finfish aquaculture species to grow the industry in New Zealand

Juvenile hāpuku at NIWA's Northland Marine Research Centre.

NIWA is New Zealand's largest marine science organisation. NIWA's coasts and ocean scientists undertake research and consultancy services that support sound management of New Zealand's complex and dynamic marine environments – for the benefit of all.

NIWA's goal is to enhance economic and social benefits from marine resources, while maintaining the biodiversity and integrity of our coastal and marine ecosystems. To achieve this, research focuses on discovering how our marine environments work, including their biological and physical composition and the interacting geological, evolutionary, ecological and human processes that shape them.

NIWA develops approaches to the management of oceanic and coastal habitats that consider whole ecosystems, ensuring vulnerable components can be protected and economic and social benefits are realised. Work is undertaken to assess the risks to marine ecosystems and commercial activity from human activities, including non-indigenous pests and diseases, and develop mitigation strategies where necessary.

NIWA's marine science includes:

- Assessing the geological and biological resources of the seafloor
- Understanding ocean currents and productivity
- Determining the effects of stressors on marine ecosystem resilience and recovery, taking an ecosystem-based approach
- Identifying threats from introduced seaweeds and animals, and developing tools to mitigate their impact
- Assessing fish stocks and developing ecosystem-based approaches to fisheries management
- Determining the impacts of fisheries and aquaculture on marine ecosystems
- Developing techniques for the aquaculture of established and new finfish and shellfish species

Irene Van de Ven

Resources

- Approximately 300 science, technical and support staff, working nationwide and collaboratively with other providers and a wide range of marine stakeholders.

Key assets

- **A world-class fleet of ocean-going and inshore research vessels**, including RV *Tangaroa*, ice-strengthened and equipped with a DP2 dynamic positioning system, which serves as the ideal platform for a wide range of marine research and commercial activities.
- A range of state-of-the-art vessel-mounted **sampling and imaging equipment**, including swath-mapping echosounders, a sub-bottom profiler, and multichannel, very high-frequency seismic reflection equipment.
- A full range of seafloor and water column **sampling and monitoring equipment.**
- **Remotely operated submarine vehicles** fitted with sampling and high-definition photographic equipment.
- A **High Performance Computing Facility**, or 'supercomputer', which runs sophisticated environmental forecasting models using data from a wide range of sources.
- The **Northland Marine Research Centre** at Bream Bay near Whangarei, where leading research into the breeding and management of farm-based finfish and shellfish aims to support industry targets for growth and environmental performance.

Investment

- Approximately **$60 million annually** for research and applied-science services.
- An additional **$120 million over the next five years** to advance marine research.

Dave Allen

Surveying toothfish and whales in Antarctica

Scientists on NIWA's deepwater research vessel *Tangaroa* completed a highly successful 6-week New Zealand-Australia Antarctic Ecosystems voyage in January–March 2015.

Their research focused on Ross Sea marine foodwebs of importance to top predators: the feeding areas of blue whales, humpback whales, and Antarctic toothfish, and the ecosystems of Antarctica which support them. Valuable oceanographic and atmospheric data were collected continually to help monitor the Southern Ocean.

The voyage covered nearly 15,000 km, recorded over 520 hours of whale songs, encountered more than 1,000 individual whales and dolphins, carried out 40 trawls, identified 111 fish and invertebrate species, achieved nearly 1,000 hours of continuous underway oceanographic and atmospheric data, conducted 35 on-board experiments to measure primary production, and much more.

The 21 scientists and 19 crew on board included scientists from NIWA and the Australian Antarctic Division, a PhD student, and two undergraduate students who participated as part of the Sir Peter Blake Trust Blake NIWA Science Ambassador Programme.

The ground-breaking research received exceptional coverage across the major television channels, newspapers and radio stations, and their digital channels, complemented by unprecedented social media channel interest.

Scientists Kim Goetz (NIWA) and Paul Ensor (Australian Antarctic Division) on the lookout for humpback whales.

Counting fish with CASAL

A NIWA-developed software package is becoming the international standard in the assessment and management of fish stocks, including some of the world's most prized species.

The software – known as CASAL – provides quantitative assessments of the status of most of New Zealand's fish stocks and shellfish fisheries for the Ministry for Primary Industries.

CASAL is also a major catch internationally, with overseas agencies adopting the package to assess Patagonian and Antarctic toothfish and broadbill swordfish fisheries.

The system can constantly readjust and manage inputs around a target quickly to maximise a catch without damaging the stock population.

CASAL can also model outcomes across a wide range of stocks, and has helped fisheries managers make changes in catch limits. As a result, we've seen improvement in some stocks, such as middle-depth (hoki) and deepwater (orange roughy).


Peter Marriott


Dave Allen

Answering the Challenge – *Sustainable Seas*

In September 2014, the National Science Challenge *Sustainable Seas* was officially launched by the Minister of Science and Innovation Hon Steven Joyce. The Challenge represents the single biggest investment in ocean research for New Zealand to date, and is designed to enhance utilisation of our marine resources within environmental and biological constraints.

The Challenge draws together eight parties: NIWA, Cawthron Institute, GNS Science, Victoria University of Wellington, and the Universities of Auckland, Canterbury, Otago and Waikato, to implement the research plan. A key strength of the plan is its development in collaboration with Māori and other stakeholders.

The Challenge is taking an Ecosystem-Based Management (EBM) approach to maximise the use of our marine resources, while maintaining a healthy and productive ecosystem. This approach will enable the Challenge to facilitate a change in the way we govern and manage the use of our marine resources, transforming New Zealand into a world leader in marine stewardship and marine economic development.

Collaboration, public engagement and participation are essential to allow the Challenge to develop the tools and methods needed to capture the economic, social, environmental, spiritual and cultural values of our marine ecosystem.

Collaborating on finfish aquaculture

NIWA, the Ministry for Primary Industries and Enterprise Northland are taking a collaborative approach to harnessing economic opportunities from finfish aquaculture. Market demand suggests a kingfish farming industry could earn Northland more than $250 million annually.

In recognition of this significant aquaculture opportunity, the collaboration agreed to seek proposals for a schematic design of a land-based kingfish farm. This design work will provide clarity to the physical footprint, capital requirements, operating costs and production expected from a 500 tonne per year operation.


Alan Blacklock

Juvenile kingfish.

Cataloguing marine life

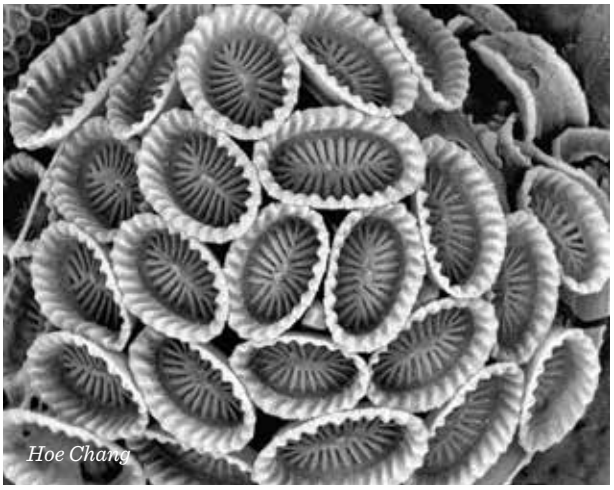
NIWA scientists have described 145 new marine plants and animals in New Zealand's Exclusive Economic Zone in the past three years – helping New Zealand meet its obligation as a signatory of the Convention on Biological Diversity. The new discoveries include sponges, corals, sea anemones, bryozoans, round worms, sand hoppers, comma shrimps, squat lobsters, sea squirts and several new seaweed and phytoplankton species.

The World Register of Marine Species (WoRMS), which is logging all the world's known marine species, relies on contributions from marine biologists from all around the world, including New Zealand. So far, 228,450 marine animal and plant species have been identified worldwide.

The New Zealand discoveries included a new species of carnivorous nematode worm (*Desmodorella* sp.) in Wellington beach sand and a planktonic microalga (*Syracosphaera pemmadiscus*) from oceanic waters.

A recent NIWA-led inventory of New Zealand's marine species counted nearly 12,500 named marine species for WoRMS. There are at least 3000 more species in New Zealand museum collections awaiting formal naming and description – we are still very much in the discovery phase with marine life.


Daniel Leduc


Hoe Chang

The carnivorous worm Desmodorella *(above) and the planktonic microalga* Syracosphaera pemmadiscus *identified by NIWA scientists contribute to a worldwide register of underwater life.*

Assessing our fish stocks

Currently, more than 80% of New Zealand's assessed fish stocks are either above, or well above, sustainable levels. NIWA's fishery stock assessments contribute substantially to that success story.

Stock assessments allow us to discover how fish populations have changed as a result of fishing, and what the effects of different management decisions are likely to be on future yields. NIWA assesses most of the fish stocks in the New Zealand quota management system and also contributes to many international fish stock assessments in our part of the world.

The data recorded from research surveys are an important input into fishery assessment models. Research surveys are one of the best ways to count the number of fish in a population at a point in time, but we cannot survey all the species all the time. So we combine the survey data with other information on catches and the population size and age structure to model the stock and to figure out why and how the population has changed.

We then use our stock assessment models to predict what will happen in the future – allowing us to advise what's likely to happen under potential management choices, like different catch limits or different minimum legal sizes.

This research gives us an understanding of the status of our stocks, allowing us to balance economic considerations and long-term sustainability.

Over the year, we carried out 12 vessel-based research surveys, providing fishery-independent estimates of abundance for more than 50 inshore and deepwater species. Over 80,000 individual fish from more than 100 different species were measured. All available information was combined in model-based stock assessments for 13 commercially important fish species that were used to inform fisheries management.

Reducing invasive marine species

The growth of biofouling on a vessel's hull reduces its fuel efficiency and is a major pathway for the spread of harmful marine organisms. International shipping is under increasing regulatory pressure to reduce fuel consumption, greenhouse gas emissions and the rate of transport of invasive species.

Regular in-water cleaning provides a solution, but brings with it the risks of contaminant release from the vessel's antifouling coatings and the escape of non-native species during cleaning.

NIWA scientists have been working with the Ministry for Primary Industries (MPI), the Department of Conservation and regional councils to develop improved methods for the emergency treatment of heavily fouled vessels and guidance for the testing of in-water cleaning equipment. With our collaborators at Cawthron Institute, NIWA completed field trials on the use of encapsulation and shrouding methods to treat heavily fouled vessels. These included assessing the efficacy of simple accelerants, such as pool chlorine and vinegar, to achieve rapid treatment. In 2014–15, the research team completed an international review of technologies for in-water cleaning of vessels and developed guidelines for MPI for their testing and application in New Zealand waters.

Monitoring ocean acidification

Long-term monitoring of ocean carbon chemistry in sub-Antarctic surface waters of the Southwest Pacific Ocean near New Zealand has shown that the pH has decreased – the water has become more acidic – over the period 1998 to 2012. This is consistent with the increase in atmospheric CO_2 recorded at the NIWA Baring Head monitoring station.

Although short-term measurements indicate that the carbon chemistry is highly variable at coastal sites round New Zealand, there is little baseline data against which to assess any future change.

To address that deficiency, NIWA has set up a coastal ocean acidification observing network of 14 monitoring sites around the country, in partnership with the University of Otago, aquaculture and fishing industry representatives, regional councils, Department of Conservation and others. The network consists of fortnightly bottle samples for dissolved inorganic carbon and alkalinity analyses, and pH sensors, which are deployed at selected sites to collect data every 30 minutes.

Seeing into the future with Atlantis

Atlantis is one of the world's best ecosystem modelling platforms. It can incorporate a huge wealth of data about the marine ecosystem and mathematically model the interactions between animals, plants and the environment. Originally from CSIRO in Australia, NIWA has used Atlantis to develop a sophisticated computer ecosystem model for Golden Bay and Tasman Bay.

We are using it to predict the changes that are likely to occur in our seas in response to fishing, climate change, and changes to the sea floor habitat. In all ecosystems there are interdependencies, and Atlantis will allow us to investigate those relationships.

Golden Bay and Tasman Bay are also important study areas within the *Sustainable Seas* National Science Challenge.

We are using the Atlantis model to integrate knowledge from the area so we can better understand the effects of past human activities and future climate change. It will allow us to understand the sorts of outcomes we can expect from different actions. What would happen if activities, such as dredging, for example, were restricted to different locations? Or, what would happen if the amount of fishing or number of aquaculture farms increased or decreased?

This critical tool is allowing us to see into the future and test different management approaches – without causing unintended adverse effects – before identifying which management decision will provide the best outcome.

Exploring underwater resources

NIWA has continued to explore the unexplored this year – mapping large areas of New Zealand's seafloor and its underlying sediments. This information is vital to the energy and minerals industries – helping them better understand and quantify the undersea resources in out vast marine estate.

This year, NIWA has invested in a new high specification sub-bottom profiler to strengthen the frontier exploration package available on its deepwater research vessel *Tangaroa*.

The $1 million profiler identifies marine ocean bottom sediments and strata, sometimes up to 200m below the surface of the seabed. This helps the industry find sub-surface formations such as carbonate accumulations, hydrocarbon or methane-based seeps and gas chimneys, which are indicative of new petroleum resources.

Plumes of escaping methane or hydrocarbon-based seeps within the water column are also being identified on *Tangaroa*.

Combining the information from both these sophisticated pieces of technology magnifies our understanding of New Zealand's seafloor and its underlying sediments. The technology on NIWA's research vessels, and the skills of the people who operate it, also produce a full suite of environmental data – from the exciting discovery of chemosynthetic communities to detailed information about the different seafloor habitats and their communities.

Dave Allen

INSPIRED RESOURCEFUL COMMITTED

Principal technician Neill Barr and marine biologist Graeme Moss at NIWA's specially constructed laboratory to test the effects of ocean acidification on marine life.

Leadership, accountability and culture

Over the year we continued to build on our refreshed NIWA values to make them even more central in defining the culture we want – one which is consistent with a stimulating, enjoyable and high performing environment.

In September 2014, we held our third Leaders' Forum. This annual, 2-day event brings together all staff with management responsibilities to update them on organisational performance and direction, and provide an opportunity to contribute to strategy, network with fellow leaders and key influencers, and celebrate the finalists in NIWA's Excellence Awards and Photography Awards. The theme of the 2014 Leaders' Forum was "Staying relevant in a fast-changing world" – recognising that people and organisations who respond and adapt to changes quickly will inevitably create a competitive advantage for themselves.

NIWA is an equal opportunity employer, and we value the strengths that a diverse workforce provides. We actively engage with employees and their representatives when reviewing and renewing workplace programmes and policies, and this includes union participation in collective bargaining (NIWA had 352 PSA members as at 30 June 2015), and consultation with staff before policy changes.

NIWA recognises its responsibility to be a good employer under Section 118 of the Crown Entities Act 2004 and operates human resources policies which are consistent with the fair and proper treatment of employees in all aspects of their employment.

Recruitment, selection and induction

In 2014/15, we recruited for 64 positions around the country. Staff turnover remains low, with retention at 93%.

Our managers are trained in recruitment and selection and supported with relevant tools and resources to ensure best practice methods and principles are applied when selecting staff. We pride ourselves on having an impartial employment process to ensure we hire the best person for the job, based on job-relevant requirements.

We emphasise a thorough induction process to properly welcome new staff and equip them with the knowledge, tools and support they need for the crucial first few months of employment. We conduct a 3-month entry interview to check how new staff are finding the work environment, and to identify and resolve any issues.

Employee development and promotion

Individual development plans are set with all staff at the beginning of the year, with a progress review at 6 months, and an end-of-year performance and development review.

Our annual workforce planning process analyses current capability in relation to market demand for our skills and services, and informs action to ensure we have the required workforce capability and capacity. This includes strategic talent review and succession planning.

We have an in-house leadership and management development programme, which includes workshops on project management, developing others, managing poor performance, leadership and emotional intelligence, and crucial conversations. We also provide workshops in a range of other areas, including science writing, presentation skills, media engagement, time management, expert witness training, health and safety and technical skills training as required.


Andrew Willsman

This year we spent more than $480,000 on professional development and conference attendances. We also spent more than $250,000 on professional memberships.

We have more than 70 group managers and programme leaders across our national science centres. As front-line science managers, they play a key role in maintaining and enhancing our research and applied science services, as well as providing mentoring and leadership for staff.

This year, 18 level promotions were awarded to staff across the country. The promotions were achieved after cases were extensively reviewed by a panel, before being recommended to the Chief Executive for final review and approval.

In addition to extensive professional development opportunities, our staff get up to three days' leave a year to pursue more personal development-focused training or related activity of their choice. This year, NIWA funded a total of 551 personal development leave days.

Weather and snow stations like this one at Castle Mount, Fiordland, supply crucial data to NIWA's climate network.

Remuneration and recognition

We continue to provide an environment that identifies, encourages and rewards excellence, innovation and high-quality services by using a remuneration structure that is competitive, fair and transparent.

We regularly review our internal relativity, and monitor and respond to market movements in remuneration. Last year, about 30% of NIWA staff exceeded expectations and were awarded a merit increase to salary over and above the general adjustment. An additional 88 staff had their remuneration reviewed and adjusted for other reasons.

Staff again had the opportunity to recognise the outstanding work of their colleagues, with the third annual NIWA Excellence Awards. Ten winners and ten runners-up were awarded trophies and cash prizes at a ceremony to celebrate their exceptional contributions. Two senior staff were also recognised with a Lifetime Achievement Award and an Extraordinary Achievement Award. All staff are eligible for nomination, this year we received more than 70 nominations.

Our people work in some of the world's most stunning environments and many of them are excellent photographers. We make extensive use of their photography as we popularise our science and communicate the value it helps create for New Zealanders. We also run regional competitions and a national final, the winners of which are celebrated at the Leaders' Forum.

Our workplace is characterised by a high level of autonomy, trust and delegated decision making. Many of our staff work flexible hours to enable them to accommodate both work and non-work commitments. Twelve per cent of our staff work less than full-time hours.

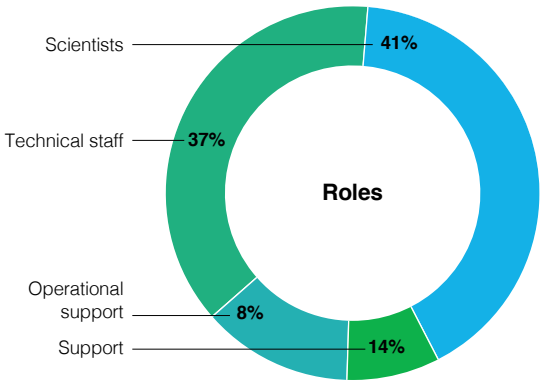
Safe and healthy environment

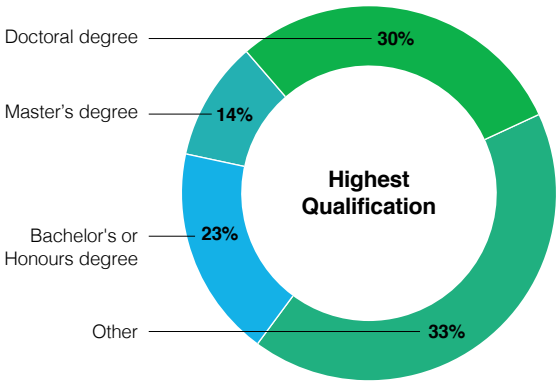
NIWAsafe – pathway to zero harm is our proactive initiative to increase safety standards to meet our staff and our customers' expectations – focused on ensuring every job is planned and achieved without harm, and everybody is responsible.

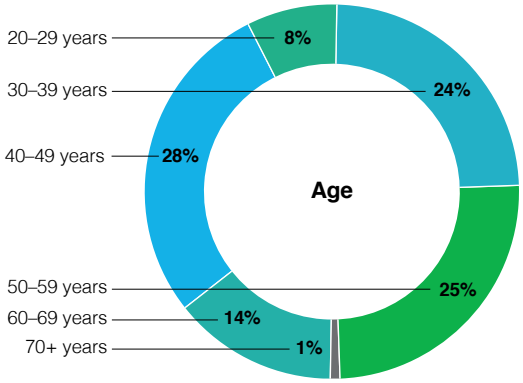
The three key elements of the strategy are safety leadership (enhancing safety leadership capability), safety systems (increasing system efficiency and effectiveness), and safety behaviour (introducing human error prevention practices). There has been a renewed focus on employee participation through the activities of elected safety representatives and regional safety teams. Six critical risk teams focus on managing particular safety risks, and the safety leadership team provides organisational oversight and direction.

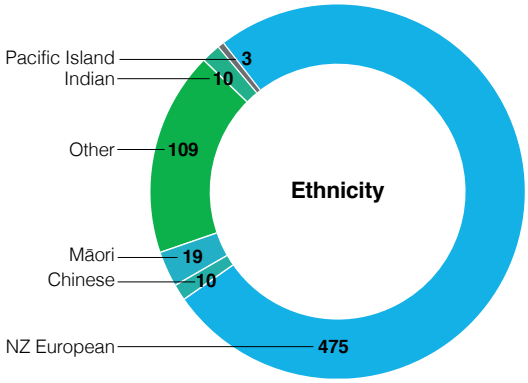
We actively promote a safe and positive working environment, and we have a comprehensive unacceptable behaviour policy, with zero tolerance for harassment and bullying. We also have professional guidelines which set out clear expectations of how we behave, communicate and interact at work. Free, confidential, external counselling support is available for any staff member who is experiencing difficulties.

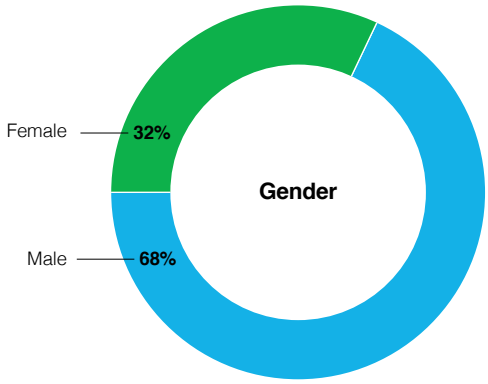
Fisheries scientist Richard O'Driscoll addresses media on Tangaroa *at the start of its 6-week voyage to Antarctica.*

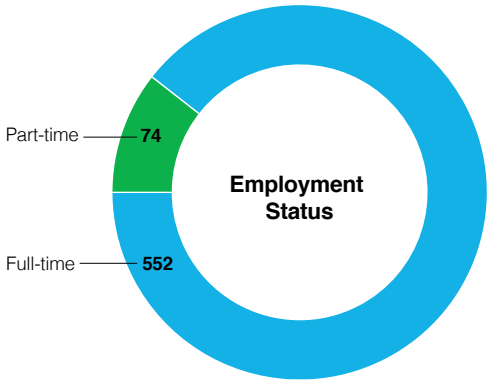












Disabilities

Total number of people with disabilities = 10 (1.6%).

Recruitment

19 new permanent positions

30 permanent replacements

Level review promotions

21 cases received for review

18 successful cases approved by panel and Chief Executive

Staff turnover

7.43% (93% staff retention) NIWA Group

PSA membership

352

Personal development

3 days a year provided for each employee for personal development.

A total of 4133 personal development hours (551 personal development leave days).

Number of staff attended national or international conferences funded by NIWA during the year:

International – 95

National – c.200

Communicating our science

1,440

total outputs

318

commissioned client reports

15

expert evidence presentations

503

conference papers and presentations including 7 keynote presentations, 184 overseas conference presentations and participation in CCAMLR.

457

published articles and book chapters (peer-reviewed)

54

conference poster presentations

5,000 media appearances with an audience of 90 million

Over the last 12 months we issued 120 media releases and positively responded to many more media enquiries, resulting in more than 5,000 media stories, and a cumulative audience of more than 90 million and an advertising space rate of $8.9 million. We also received excellent coverage in new media channels.

Our social media engagement continued to increase. NIWA content on Twitter received more than 187,000 viewings over the year, and our content on Facebook reached more than 331,500 people over the year.

We continue to strengthen our engagement with the science community by directly sponsoring 17 conferences throughout the year, and by our people attending and actively contributing to many more.

We are also the lead sponsor of five major regional science and technology fairs and secondary sponsors of another six. These highly successful events reach out to thousands of children each year, their parents and the community at large, encouraging the use of science to provide the answers to some aspect of their lives and promoting the value of science to a wide audience.

NIWA's core values are part of our ongoing efforts to maintain a positive and strong culture, and be clear about what we need to promote, and stand for, in order to continue to be a successful organisation.

Safety

Working safely is paramount at all times.

- Zero harm is our safety target for our people and those working with us.
- We take personal responsibility for the safety of ourselves and others.
- We are always safety conscious, thinking "What am I about to do? What could go wrong? How can I do it safely?"
- We maintain high standards of safety in all working environments.
- We report all hazards, incidents and near misses, acting on and learning from them.
- We continually improve our safety systems and processes.

Excellence

We strive for excellence in everything we do.

- We apply the highest standards of rigour to our work.
- We are creative and innovative in our thinking and apply leading-edge practices.
- We are highly professional in the way we operate.
- We are proud of our reputation for high-quality science.
- We are efficient, effective and resourceful, seeking to eliminate waste and maximise opportunities.

Customer focus

We provide our customers with an outstanding service and experience.

- We recognise that NIWA wouldn't exist without its customers.
- We all work together to ensure a positive customer experience.
- We value and respect our customers, and act to ensure excellent and enduring relationships with them.
- We communicate with our customers openly and proactively.
- We deliver on our commitments to customers – in full, on time and within specifications.
- We seek customer feedback to help us improve.

Adélie penguins.

Dave Allen

Agility

We are agile, resourceful and responsive to opportunities and challenges.

- We actively create, identify and develop new opportunities.
- We react quickly and flexibly to changing priorities.
- We are positive, solution-focused and future-oriented in our outlook.
- We recognise change as continuous, and treat it as an opportunity.
- We are committed to continuous learning and improvement.

People and teamwork

We are 'OneNIWA' and work collaboratively for the greater benefit of NIWA and our customers.

- We help and support our colleagues, treating each other with courtesy and respect.
- We value diversity and respect other cultures.
- We value the opinions, knowledge and contributions of others, and celebrate success.
- We willingly share our expertise.
- We all take responsibility for getting things done.
- We listen openly and communicate honestly and constructively.
- NIWA's interests and reputation take precedence over advancing our own individual interests and reputation.

Integrity

We are honest, trustworthy and reliable in our work and our relationships with others.

- We uphold the highest ethical standards.
- We deliver.
- We take ownership and are accountable for our actions.
- We provide accurate, evidence-based information and advice.
- We maintain objectivity at all times, avoiding advocacy and bias.
- We are viewed as trusted professionals in our areas of expertise.
- We avoid or declare all conflicts of interest.

Dave Allen

2015 NIWA EXCELLENCE AWARDS

Our annual NIWA Excellence Awards celebrate the achievements of staff who have made an extraordinary contribution. Staff are nominated by their peers, and finalists are then selected by a representative panel of staff, for ratification by the Executive Team.

The NIWA Excellence Award

Research
Mal Green

Mal's Northland Sediment Study is an exceptional piece of research. The investigation of sediment loading in sensitive estuaries is one of the most complex areas of water research. Excess sediment in rivers and estuaries is New Zealand's most widespread water quality problem, and Mal's research – recognised by the Ministry of Business, Innovation & Employment and the Ministry for the Environment – shows how managers can identify limits that are achievable, affordable and use the natural assimilative capacity of ecosystems.

Applied Science
Rob Bell

Rob has more than 34 years' experience as a coastal/environmental research scientist and engineer. He is a leading expert on natural hazards, risk assessment and climate change impacts and adaptation (sea-level rise) associated with the coastal zone. Rob is also an authority in coastal infrastructure assessments and design, coastal environmental impact investigations and coastal erosion. He has an exceptional record in the application of hazard science and his work has influenced policy and planning and contributed to RMA Environment Court hearings.

Early Career Science
Donna Sutherland

Donna's recently completed PhD was an outstanding achievement, and she received the University of Canterbury, School of Biological Sciences, Highest Publication Achievement Award in 2014. She published eight peer-reviewed articles in international journals on the performance of high rate algal ponds for wastewater treatment. Donna's research has contributed significantly to wastewater algal biofuel science, and her research on high rate algal ponds has helped demonstrate that wastewater treatment ponds can be upgraded to reliably improve treatment.

Science Communication
Dave Allen

Dave produces video and still images of the highest standard. His exceptional imagery during the 2015 Antarctic Expedition enabled NIWA to generate and maintain high interest in the voyage and its scientific objectives over many weeks. He is a natural storyteller who consistently helps maintain our high profile in mainstream and social media, and greatly facilitates the transfer and adoption of our science and helps demonstrate the economic, social and environmental benefit it brings to New Zealand.

Project Delivery
Barry Waugh

Barry has contributed substantially to the successful delivery of commercial and CoRE-related projects, combining his technical knowledge of operational hydrology and general data collection technologies, with a highly innovative approach. He has become the ideal "go-to person" for the establishment of hydrological or environmental projects in the Pacific and beyond. His experience and willingness to work with clients to ensure they grow their knowledge has led to enduring relationships and enhanced our reputation for successful project delivery.

Customer Focus
MS Srinivasan

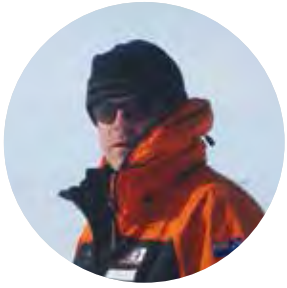
MS is extremely proactive in contacting customers, seeking opportunities to understand what they need and working with them to try to deliver the best NIWA can offer – always seeking feedback and ways to improve services. MS has led NIWA's efforts in working with various councils, primary sector agencies and farmers to transform research and development into 'usable tools in the field', and he was instrumental in developing the IrriMet tool to help farmers with irrigation decisions.

Operational Innovation
Neill Barr

Neill has significantly advanced NIWA's expertise and capability in experimental ocean acidification and climate change science by developing three world-class experimental facilities – an indoor facility, an outdoor mesocosm facility, and an innovative portable system for use in the Antarctic, which has since been applied to examine the impacts of ocean acidification on fish larvae. Without Neill's blend of technical capability, scientific knowledge and dedication to the development of these facilities, many of our experiments would not be possible.

Support Services
Janine Alliston

Janine delivers first-rate finance and accounting services, consistently managing her corporate activities and responsibilities and providing sound guidance and advice to the business. She has extensive knowledge and an excellent understanding of procedural requirements, and coordinates the annual external audit. Janine also demonstrates ethical leadership and commitment to NIWA values and a positive attitude to work responsibilities.

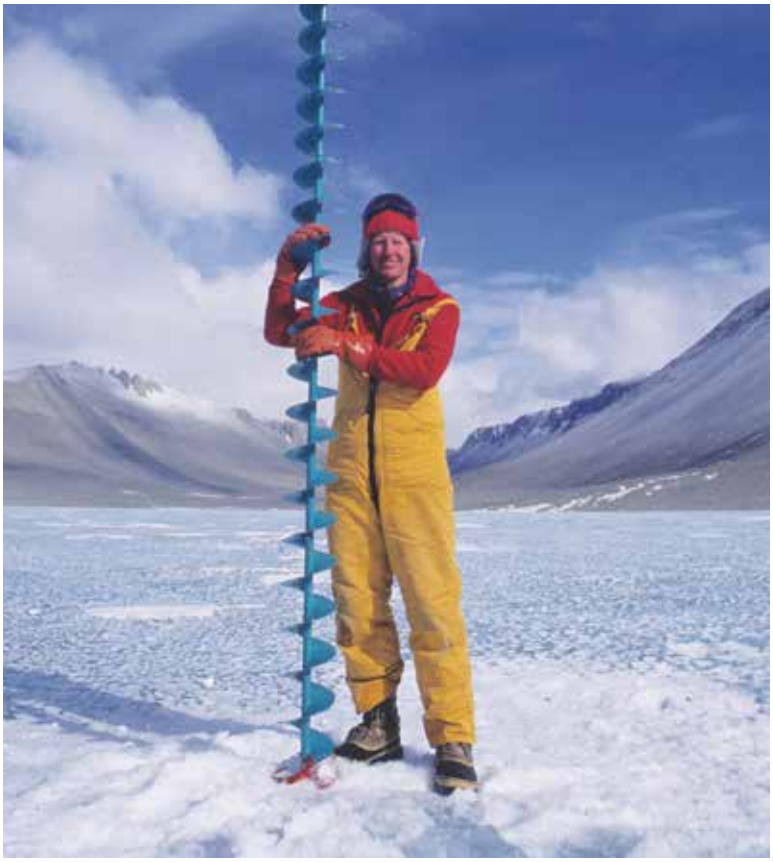


Leadership
Mike Williams

Mike played a critical role in advancing the research strategy for the *Deep South* National Science Challenge, particularly in the development of the research plans that will bring revenue of $1.5 million annually, along with significant leadership responsibilities, for NIWA throughout the challenge. As a NIWA Ambassador he has continued to highlight the important contribution that NIWA's Southern Ocean and Antarctic science makes to the global understanding of our climate system. Mike has also played a key role in mentoring early career scientists.

Health & Safety
Colin Grace

Colin has had considerable input into NIWA safety teams. He is a true champion for staff, consistently promoting safe working environments and encouraging safe thinking. He is a great rolemodel for promoting safety, and he walks the talk by demonstrating safety everywhere. His proactive and thorough approach has encouraged many staff to work more safely and adopt safe working conditions and procedures.



Lifetime Achievement Award

Clive Howard-Williams

Clive's extensive achievements as an aquatic ecologist span more than 35 years and cover the globe. He is a Fellow of the Royal Society of New Zealand, an Adjunct Professor at the University of Canterbury and holder of the New Zealand Antarctic Medal. He also has the distinction of having a prominent point in Antarctica named after him.

Clive was NIWA's Chief Scientist, Freshwater and Estuaries from 2005 to June 2015, and he is now concentrating on the role of science in addressing water management issues and water policy.

Based in NIWA's Christchurch office, Clive is renowned for his hard work, his ability to maintain an extensive international science network, and his genuine care and concern for his colleagues. He is also admired for his good humour, even when his home was so badly damaged in the Christchurch earthquakes.

2015 NIWA PHOTOGRAPHY AWARDS

Many of the world's most beautiful environments act as a stunning backdrop for the work carried out by NIWA staff. That is why we hold an annual photography competition, which is often featured in a range of media publications and websites as well as the NIWA calendar and our magazine *Water & Atmosphere*.

The competition is judged in several categories in regional heats and national finals, and this year special thanks go to Gerry le Roux from Science Lens, Ross Giblin from Fairfax Media and Dave Allen from NIWA for their time in judging the awards.

Our People

Crispin Middleton — Toado Selfie

Scientific diver Crispin Middleton is surrounded by panicked Starry Toado Pufferfish at the Poor Knights Islands Marine Reserve. The Starry Toado are rarely seen pelagic pufferfish which usually live in deep, blue, open water. On very rare occasions, the fish stray too close to land and immediately get attacked by hungry kingfish and snapper.

The judges commented that they appreciated the tight crop and weight provided by Crispin's arms and body at the bottom of the image. "Intense engagement with the view and excellent exposure and sharpness. The world would be a better place if more selfies were this good!"

Special Award

Alvin Setiawan — Tui in flight

This tui was photographed on Tiritiri Matangi Island in the Hauraki Gulf. The judges described it as a great action shot, employing sharp detail and motion blur in the same image. "It has a lovely sharpness and detail around the bird's head with effective use of shallow depth of field to isolate the bird against its surroundings."

Public Choice

Chris Brandolino — Whangaparoa

This photograph was a standout winner in the public choice category, voted for via social media. A trip to the beach at Army Bay, Whangaparoa provided the opportunity to capture a winning shot.

Our Places (left)

Rob Murdoch — Penguins on Ice

Three penguins run beside a track of broken ice created by the US icebreaker *Nathaniel Palmer* into McMurdo Sound. The judges said this was a stunning image with strong, visual design. It was successful because of the extreme visual simplicity and made effective use of simple diagonal compositions of shapes and lines, well balanced by the penguins.

Our Work

Alison Kohout — Ice Edge

The judges loved this well-spotted and well-captured moment which resulted in a clever, humorous image.

"It was well executed – the dashes of colour on the otherwise white landscape work really well. The image piques the viewer's curiosity, drawing you in and making you want to know more."

BOARD OF DIRECTORS

Prof. Keith Hunter

Keith has been Pro-Vice-Chancellor of Sciences at the University of Otago since early 2010. Before that, he was Head of the Department of Chemistry. A graduate of the University of Auckland, Keith joined the department at Otago in August 1979 after five years of PhD and postdoctoral study in Britain and France. His research speciality is chemical oceanography and he is one of New Zealand's delegates to the UN's Scientific Committee on Oceanic Research.

Prof. Gillian Lewis

Gillian is a professor of microbiology and with the Faculty of Science at the University of Auckland. She was formerly Associate Dean of Research and Head of the School of Biological Sciences. She is Chair on the Board of Grafton Halls of Residence and Deputy Director of the Centre for Microbial Innovation. Gillian is a former President of the New Zealand Microbiological Society. She has a PhD in Microbiology from the University of Otago. Her research focuses on the interactions of complex microbial communities and their response to natural and anthropogenic impacts in freshwater environments.

Nick Main Deputy Chairman

Nick is a chartered accountant and was Chief Executive and later Chairman of Deloitte in New Zealand. More recently, he was Deloitte's Global Managing Partner of Sustainability and Climate Change Services and Global Chief Sustainability Officer, based in London. He has also served as Deloitte's Global Chief Ethics Officer. Nick currently chairs the Middlemore Foundation for Health Innovation, is a member of the Westpac New Zealand Sustainable Business External Advisory Panel, and is co-opted onto the Finance and Audit Committee for Counties Manukau DHB.

John Morgan Chief Executive

John joined NIWA as Chief Executive in April 2007. He has extensive senior executive and governance experience in public and private sector organisations covering a range of markets and activities including business, science, education and sport. His science sector roles have included Chairman of Science New Zealand, Chief Executive of AgriQuality Ltd, Executive Director of Orica New Zealand Ltd, and Chairman of New Zealand Pharmaceuticals Ltd. John is passionate about the role science can play in transforming New Zealand's economy, environment, society and global reputation.

Chris Mace Chairman

Chris is an Auckland-based businessman. He chaired the Crown Research Institute ESR in the 1990s, and later Antarctica New Zealand. He is Commissioner of the Tertiary Education Commission, a founding trustee and life member of the Sir Peter Blake Trust and continues as a trustee of the Antarctic Heritage Trust. Chris was awarded a CNZM for services to Antarctica and the community and was appointed Chairman of NIWA in July 2009.

Dr Helen Anderson

Helen chairs the BRANZ and Fulbright NZ boards and is an independent director of DairyNZ and WREDA. She also serves on the Massey University Council and the National Council of the Institute of Directors. She was Chief Executive of the Ministry of Research, Science and Technology for six years, preceded by six years as Chief Science Adviser. Helen chairs or is a member of advisory boards for LINZ, DIA, and the NZ Police. She has a PhD in geophysics from Cambridge University and enjoys keeping up-to-date with the latest science developments.

Jason Shoebridge

Jason is Managing Director of TNS New Zealand. He has led consulting assignments across a range of industries and disciplines in New Zealand and overseas. Before his consulting career, Jason held a number of senior commercial and financial management posts, both internationally and in New Zealand, in large corporates and with an international chartered accounting firm.

Mike Pohio

Mike is a Hamilton-based director. More recently, he was the Chief Executive of Tainui Group Holdings. Mike is currently the Pro Chancellor for the University of Waikato and holds directorships on the boards of Transpower and Bay Radiotherapy Services. He is also Chairman of BNZ Partners, Waikato Region. Mike holds an MBA from IMD, Lausanne and an FCA from the Chartered Accountants Australia & New Zealand.

EXECUTIVE TEAM

Patrick Baker
CFO and Company Secretary

MEng, Brunel University, London; BBus (Accounting and Management), GDip (Professional Accounting), Open Polytechnic of New Zealand; CA

Patrick is a Chartered Accountant. He began his career as an engineer with Ford Motor Company in the UK before moving into financial management. He held senior finance management positions in Europe and the Middle East before joining Ford New Zealand in 2004. After settling in New Zealand in 2012, he was appointed CFO of The Network for Learning Limited. He joined NIWA as CFO and Company Secretary in May 2014.

Geoff Baird General Manager, Communications and Marketing

BSc Hons (Ecology), Victoria University of Wellington

Geoff has extensive experience in science publishing and communication from working with the Ministry of Agriculture and Fisheries, MAF Fisheries and NIWA. He became NIWA's Communications Manager in 2003 and General Manager, Communications and Marketing in July 2007, with a focus on reinforcing the values underlying the NIWA brand and demonstrating how NIWA enhances the benefits of New Zealand's natural resources.

Dr Barry Biggs General Manager, Operations

BSc Hons(Botany and Geology), Victoria University of Wellington; PhD (Stream Ecology), University of Canterbury

Barry is an environmental scientist with 38 years' experience into the effects of changes in land use and flows on river ecosystems. He has been extensively involved with planning and running some of New Zealand's largest RMA consenting projects. He has wide project management experience, was NIWA's Christchurch Regional Manager for three-and-a-half years, Chief Scientist of Environmental Information and Pacific Rim for three years, and has been General Manager, Operations since July 2008.

John Morgan
Chief Executive

John joined NIWA as Chief Executive in April 2007. He has extensive senior executive and governance experience in public and private sector organisations covering a range of markets and activities including business, science, education and sport. His science sector roles have included Chairman of Science New Zealand, Chief Executive of AgriQuality Ltd, Executive Director of Orica New Zealand Ltd, and Chairman of New Zealand Pharmaceuticals Ltd. John is passionate about the role science can play in transforming New Zealand's economy, environment, society and global reputation.

Dr Rob Murdoch
General Manager, Research

PhD (Marine Science), University of Otago

Rob has a specialist interest in oceanography and marine ecology, and has been a practising scientist on projects associated with the Southern Ocean, aquaculture, oil and gas exploration and marine conservation. He has overseen the planning and direction of NIWA's science and the operation of the research vessels since 1999, and helps manage NIWA's relationships with key stakeholders and collaborators.

Dr Mary-Anne Dehar
General Manager, Human Resources

PhD (Psychology), PGDipPsych (Comm), University of Waikato

Mary-Anne is a registered psychologist, specialising in industrial/organisational psychology. Before joining NIWA in 2008, she worked as a senior human resources consultant for 15 years, both in private practice and for several large consulting firms.

Andrew Watkins
General Manager, Information Technology

BSc (Computer Science & Geology), University of Aston in Birmingham

Andrew joined NIWA in 2009 to form the Systems Development Team and became General Manager for IT in May 2015. Andrew brings to the role skills as a software architect, developer and specialist in human computer interaction. This reflects an emphasis within NIWA for digital services delivery and a focus on enabling both customers and science staff to derive new knowledge and make better decisions based on environmental information and forecasting.

Dr Bryce Cooper
General Manager, Strategy

PhD (Microbiology), University of Waikato

Bryce is a graduate of the London Business School Senior Executive Programme. He has held research leader and regional manager roles in NIWA, and currently oversees NIWA's strategy development, including initiatives to transfer research to end users and the building of partnerships with businesses and central and local government.

SCIENCE MANAGEMENT TEAM

Dr Sam Dean Chief Scientist, Climate and Atmosphere, Hazards

PhD (Physics), University of Canterbury

Sam joined NIWA in 2006 and commenced his current management role in 2015. He is an expert on using climate models to understand the drivers of climate variability in New Zealand and Antarctica, and in particular the effect of human-induced climate change on weather extremes. Recently, he has also been part of a team investigating the role of ocean waves in Antarctic sea-ice trends.

Andrew Forsythe Chief Scientist, Aquaculture

DVM, University of Prince Edward Island

Andrew joined NIWA in 2005, bringing with him more than 20 years' experience in the North American and European aquaculture industries. He has extensive expertise in the design and operation of recirculating aquaculture systems, has provided ambulatory veterinary services for commercial and enhancement aquaculture in western Canada, and has managed freshwater production for a major salmon farming company. Andrew took up his current role in 2007.

Dr Barb Hayden Chief Scientist, Coasts and Oceans

PhD (Marine Biology), University of Otago

Barb has a research background in marine biosecurity and the environmental sustainability of aquaculture. Today she leads NIWA's coasts and oceans research, which focuses on ecosystem-based approaches to managing activities in New Zealand's marine estate, so that economic and social benefits are realised while vulnerable components of the ecosystem are protected.

Dr Rosemary Hurst Chief Scientist, Fisheries

PhD (Zoology), Victoria University of Wellington

Rosemary has worked in fisheries research in New Zealand since 1979. She is a specialist in middle-depth and inshore fisheries resource surveys and stock assessment and has also conducted research on fish communities, ocean climate effects on fisheries, and trawl catchability and selectivity. She was a regional manager at NIWA Wellington for eight years and has been in her current role since 2010.

Dr John Quinn Chief Scientist, Freshwater and Estuaries

PhD, Massey University

John has worked in freshwater research and management in New Zealand since 1980. He is a river ecologist with expertise in land-water interactions, riparian management, water quality, and invertebrate ecology. He has led NIWA's research in aquatic restoration for a decade and took up his current role in June 2015.

Dr Jochen Schmidt Chief Scientist, Environmental Information

PhD (Geography), University of Bonn

Jochen has a background in hydrology, geomorphology, soil science, geo-informatics, and hazards and risk assessment. He worked for Landcare Research between 2001 and 2003 and was instrumental in developing the New Zealand Digital Soil Map ('SMAP'). He joined NIWA in 2003 and coordinates systems for collecting, managing and delivering environmental information – ensuring they are robust and meet best-practice standards. Jochen leads NIWA's engagement with the primary sector.

Dr Clive Howard-Williams Chief Science Advisor, Natural Resources

PhD (Ecology), University of London

Clive is an aquatic ecologist with more than 35 years' experience, specialising in freshwater and estuarine water quality and aquatic ecosystem processes. His expertise results from research in a number of countries from the tropics to the polar regions. He is now focused on the development of science strategy and on the role of science in addressing water management issues and water policy. He is a Fellow of the Royal Society of New Zealand, an Adjunct Professor at the University of Canterbury and holder of the New Zealand Antarctic Medal.

Dr Mark Bojesen-Trepka Manager, Marketing and Industry Engagement

BSocSc, MBA, PhD (Marketing and Technology Management), University of Waikato

Mark is an industrial marketer, and has led the marketing, product development, technology-transfer and business-development effort for a number of firms in the plastics, steel and primary sectors. Past roles include National Marketing Manager for BHP Steel Building Products, National Marketing Manager for ICI Resins and Adhesives Division and General Manager for NorthFert.

Rob Christie Manager, Marine Resources

BSc (Hons) (Environmental Science & Technology), Middlesex University, MCIWEM, CSI

Rob is a chartered scientist with more than 20 years' international experience. He has held senior management positions in environmental consultancy and science sectors in the UK, Australia and New Zealand. Rob joined NIWA in 2013 and manages NIWA's Marine Resources and the application of NIWA's marine science and helps manage NIWA's marine research vessels.

Greg Foothead General Manager, Vessel Operations

NZCE (Mechanical), Central Institute of Technology

Greg is a certified automotive engineer. Before Joining NIWA Vessels as Engineering Manager in 2004, he managed a marine and industrial supply and repair company. He has also worked for Mitsubishi Motors, in various technical roles, in New Zealand, Australia and Europe. Greg has managed NIWA's research vessels *Tangaroa, Kaharoa* and *Ikatere* since December 2010.

Alan Grey Manager, MBIE Research

MSc Hons I (Geology), University of Canterbury

Alan has a science background in ecology and earth sciences. He has extensive experience in research administration and science and technology programme evaluation, both for NIWA (since 1998) and as a programme manager for FRST. He oversees NIWA's obligations to government funding agencies and its responsibilities for undertaking research for the benefit of all New Zealanders, and evaluation of the impact and value of NIWA research.

Dr Scott Larned Manager, Freshwater Research

PhD (Ecology and Evolution), University of Hawai'i

Scott has carried out ecological research around the Pacific and in rivers, rainforests, coral reefs, deserts, mudflats, crater lakes, kelp forests and aquifers. He is a specialist in nutrient dynamics and algal ecology. At NIWA, Scott leads projects and programmes in water quality, river ecology, and surface water–groundwater science. His current role began in June 2015.

Douglas Ramsay Manager, Pacific Rim

BEng (Civil Engineering), University of Aberdeen; MSc (Water Engineering), University of Strathclyde; MBA, University of Southern Queensland; CEng; MICE; MCIWEM; FRGS

Doug is a chartered engineer. He joined NIWA in 2003, following roles with HR Wallingford in the UK and the Government of Kosrae in the Federated States of Micronesia. He specialises in coastal hazard management and coordinates NIWA's international commercial work, focusing on the Pacific and Asia regions.

Marino Tahi Manager, Māori Strategy & Engagement

MBA, Massey University; BA (Māori Resource Management) and BCA (Management and commercial law), Victoria University of Wellington

Marino Tahi joined the NIWA Science Management team in 2015. He cames to NIWA from Landcare Research where he was Māori Partnerships Manager since 2006. He leads NIWA's endeavours to maximise the transfer of natural resources and environmental science knowledge to Māori entities and communities, leading Te Kūwaha and working across NIWA staff to achieve this. His tribal affiliations are Ngāi Tūhoe, and he comes from Ruatahuna, a small settlement in Te Urewera.

OPERATIONS MANAGEMENT TEAM

Ken Becker Regional Manager, Auckland

BSc Hons (Marine Biology), University of Liverpool; PGDip (Professional Ethics), University of Auckland

Ken has 35 years' experience in marine science. Before joining NIWA as a regional manager in 2005, he worked for Auckland Regional Council on resource management regulation, planning and policy development in water quality, wastewater treatment, stormwater management and water resource allocation.

Dr Michael Bruce Assistant Regional Manager, Auckland

PhD (Aquaculture), University of Stirling

Michael's background is in fish nutrition and he has 25 years' experience in aquaculture research and working with industry. He joined NIWA in 1999 and was appointed Assistant Regional Manager for Auckland in 2011, with operational responsibility for Bream Bay Aquaculture Park. As well as a broad range of operational management skills, Michael also leads the Aquaculture Production science programme.

Dr David Roper Regional Manager, Hamilton

PhD (Marine Science), University of Otago

David has more than 30 years' experience as an environmental scientist, specialising in marine and freshwater ecology, environmental impact assessment and resource management with NIWA, ECNZ and Mighty River Power. At NIWA David has had experience as a project manager, project director, and group manager, and has been Regional Manager, Hamilton, since 2002.

Dr Julie Hall Regional Manager, Wellington

PhD (Aquatic Toxicology), University of Manitoba

Julie has a science background in phytoplankton, microbial food web and zooplankton studies in both marine and freshwater and has worked for both DSIR and NIWA. Since 2008 she has been one of the Regional Managers in Wellington and in June was appointed Director of the *Sustainable Seas* National Science Challenge. She will split her time between this role and her Regional Manager position.

Dr Alison MacDiarmid Regional Manager, Wellington

PhD (Zoology), University of Auckland

Alison specialises in behavioural ecology, with broad interests in coastal reef ecology and management, marine ecosystem risk assessment, closed area management, and historical marine ecology. She leads NIWA's Marine Ecosystem Trophic Structure and Function programme. Alison was the Marine Ecosystems Group Manager before joining the Operations Management Team in 2015.

Dr Ken Grange Regional Manager, Nelson

PhD (Marine Ecology), Florida International University

Ken is a marine ecologist. He has led research into the marine environment of New Zealand's coastal ecosystems and fiords, particularly the ecology of black corals, with the Oceanographic Institute, DSIR, and then NIWA in Wellington. Ken has extensive staff and project management experience and is a member of the ministerial appointed Fiordland Marine Guardians. He took up his current role in 1994.

Charles Pearson Regional Manager, Christchurch

BSc Hons (Statistics), University of Canterbury; MSc Hons (Engineering Hydrology), National University of Ireland

Charles is a hydrologist specialising in the analysis of hydrological and other geophysical and climatological data for purposes such as estimating flood risks. He is also the World Meteorological Organization's Hydrological Adviser for New Zealand. Charles oversees eight science groups, the Instrument Systems Group and six environmental information field teams, and is a project director of more than 60 projects.

Dr Graham Fenwick Assistant Regional Manager, Christchurch

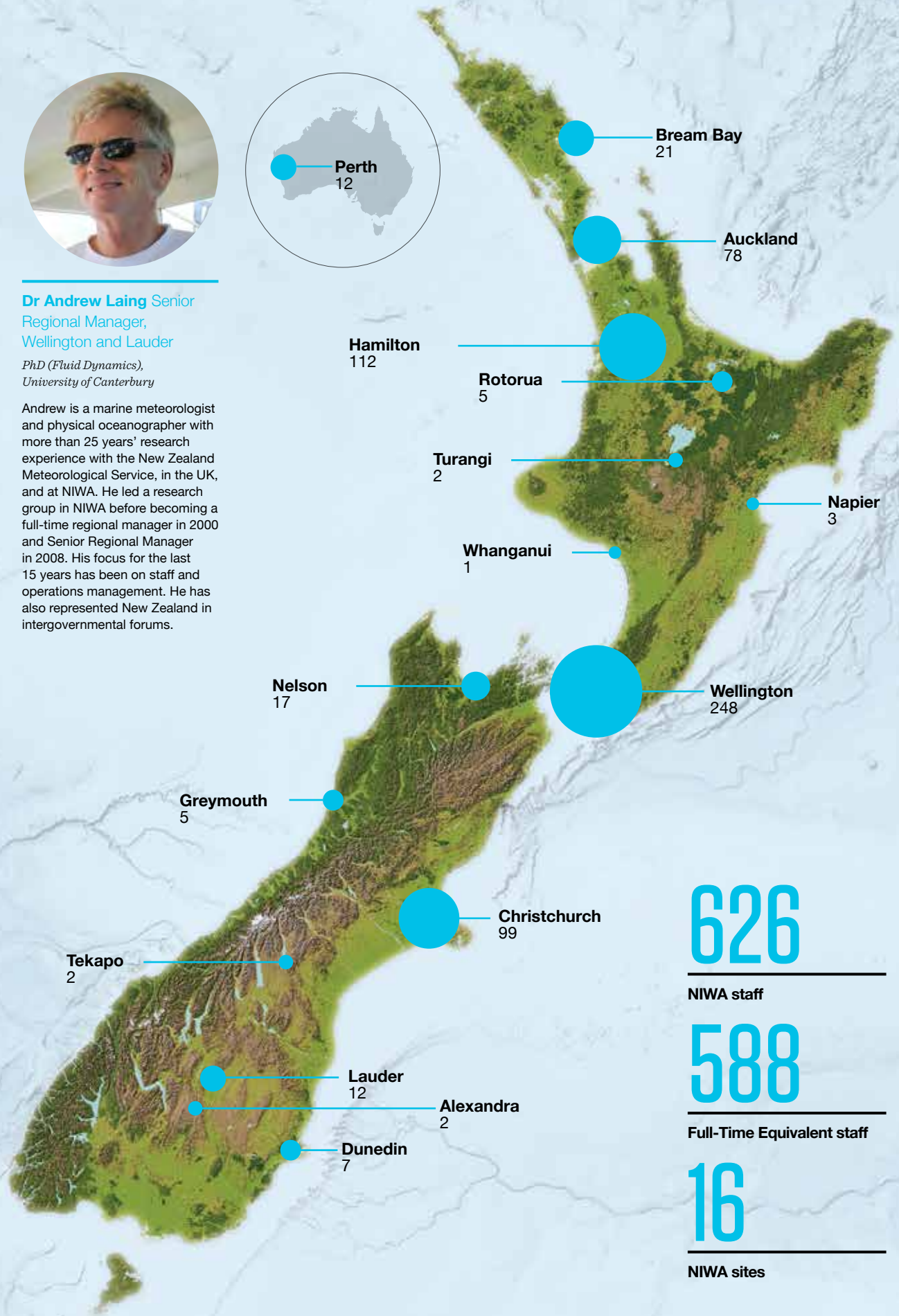
Dip BA, PhD (Marine Biology), University of Canterbury

Graham has extensive experience in marine benthic ecology and crustacean biodiversity, and worked on diverse projects from sub-Arctic Canada to New Zealand's subantarctic and Antarctica. Graham continues to champion groundwater ecology in New Zealand. He joined NIWA in 2002 and brought his blend of science, business and academic experience to the Operations Management Team in 2006.

Dr Andrew Laing Senior Regional Manager, Wellington and Lauder

PhD (Fluid Dynamics), University of Canterbury

Andrew is a marine meteorologist and physical oceanographer with more than 25 years' research experience with the New Zealand Meteorological Service, in the UK, and at NIWA. He led a research group in NIWA before becoming a full-time regional manager in 2000 and Senior Regional Manager in 2008. His focus for the last 15 years has been on staff and operations management. He has also represented New Zealand in intergovernmental forums.



626

NIWA staff

588

Full-Time Equivalent staff

16

NIWA sites

Rawpixel iStock

STATEMENT OF CORE PURPOSE OUTCOMES

NIWA is New Zealand's leading natural resources and environmental science services provider. Our purpose, set out in our Statement of Core Purpose, is to:

- enhance the economic value and sustainable management of New Zealand's aquatic resources and environments
- provide understanding of climate and the atmosphere
- increase resilience to weather and climate hazards to improve the safety and wellbeing of New Zealanders.

We are expected to fulfil our purpose through the provision of research and transfer of technology and knowledge in partnership with key stakeholders, including industry, government and Māori, to achieve six key outcomes:

1. Increase economic growth through the sustainable management and use of aquatic resources.
2. Grow renewable energy production through developing a greater understanding of renewable aquatic and atmospheric energy resources.
3. Increase the resilience of New Zealand and southwest Pacific Islands to tsunami and weather and climate hazards, including drought, floods and sea-level change.
4. Enable New Zealand to adapt to the impacts and exploit the opportunities of climate variability and change and mitigate changes in atmospheric composition from greenhouse gases and air pollutants.
5. Enhance the stewardship of New Zealand's freshwater and marine ecosystems and biodiversity.
6. Increase understanding of the Antarctic and Southern Ocean climate, cryosphere, oceans and ecosystems and their longer-term impact on New Zealand.

The information in this section of the Annual Report demonstrates how NIWA is delivering on its expected outcomes.

NIWA's research and applied-science services are delivered through our science- and sector-focused management units (see over page).

Each centre conducts a wide range of research aimed at enhancing the economic value and sustainable management of New Zealand's aquatic resources and environments, or improving our understanding of climate and the atmosphere and increasing our resilience to related hazards. Much of our work is directly applicable to a wide range of commercial operations.

National Aquaculture Centre

NIWA has been designated by the Government as the lead Crown Research Institute (CRI) in aquaculture. We focus on supporting the industry's growth targets, particularly through the development of new high-value species which can be farmed with a low environmental footprint.

Our work includes:

- developing high-performance aquaculture
- assessing and modelling the environmental effects of marine farm operations
- providing advice on designing and managing marine farms, and providing associated training
- conducting research into fish health
- providing breeding services
- conducting feed trials.

niwa.co.nz/our-science/aquaculture

National Atmosphere Centre

Understanding the complex relationship between atmospheric composition and climate has never been more important, as extreme weather events linked to climate change make their presence felt. NIWA has been designated by the Government as the lead CRI in research and services relating to the understanding of our climate and atmosphere.

Our work includes:

- quantifying the exchanges of greenhouse gases between atmosphere, ocean and biosphere
- quantifying the relationship between atmospheric composition and climate
- measuring agricultural greenhouse gas emissions.

niwa.co.nz/our-science/atmosphere

National Climate Centre

Understanding how our climate behaves, and is changing, is of profound importance to all New Zealanders. NIWA has been designated by the Government as the lead CRI in research and services relating to the understanding of our climate and atmosphere.

Our work includes:

- observing, analysing and documenting the climate of New Zealand, the southwest Pacific, the Southern Ocean and Antarctica
- understanding climate processes and causes
- modelling future climate – from seasons to centuries ahead
- developing options for adapting to climate variability and change.

niwa.co.nz/our-science/climate

National Centre for Coasts and Oceans

NIWA has been designated by the Government as the lead CRI in aquatic resources and environments (including coastal environments), aquatic biodiversity and biosecurity, and oceans – to provide the knowledge needed to support the sound management of our marine environments and resources. This ensures the vast economic, social and environmental benefits of our extensive marine estate can be realised.

Our work includes:

- conducting research into physical oceanography, ocean geology, marine ecology, primary production and microbial processes
- undertaking environmental impact assessments
- determining rates of coastal erosion, and climate change impacts on the coast
- investigating impacts of coastal outfall and discharges
- habitat mapping and swath bathymetry of coastal environments.

niwa.co.nz/our-science/coasts

National Centre for Environmental Information

Data which are precise, reliable and consistently comparable are fundamental to every branch of NIWA's science, and vital to many other end users. The centre is recognised as leading environmental monitoring and observation, information management, and the delivery of high-quality, interoperable environmental data which can be used for many purposes.

Our work includes:

- monitoring the environment through our national observation services and networks
- managing the information we acquire
- delivering information in user-focused ways
- acquiring, storing and disseminating metadata – information about how, where, when and by whom environmental information has been collected.

niwa.co.nz/our-science/ei

National Fisheries Centre

Robust science is critical to the sustainable use of New Zealand's significant marine and freshwater fisheries. NIWA has been designated by the Government as the lead CRI in the delivery of research and services relating to freshwater and marine fisheries.

Our work includes:

- assessing fisheries resources within New Zealand's Exclusive Economic Zone
- monitoring and assessing international fisheries
- determining the environmental impact of fisheries.

niwa.co.nz/our-science/fisheries

National Centre for Freshwater and Estuaries

Meeting increasing and often competing demands for clean water is one of the biggest challenges facing the planet this century. NIWA has been designated by the Government as the lead CRI in aquatic resources and environments (with a focus on surface freshwaters), aquatic biodiversity and biosecurity, freshwater fisheries, and aquatic-based energy resources. We provide public information on river and lake conditions across New Zealand, including water quantity and quality. We also develop and distribute new water-related technology and management tools.

Our work includes:

- monitoring and providing advice on water quality
- catchment modelling
- assessing and managing flow
- advising on the management of freshwater species and habitats
- providing freshwater data online and specialist analytical services.

niwa.co.nz/our-science/freshwater

National Natural Hazards Centre

New Zealanders need little reminding of how destructive nature can be. NIWA has been designated by the Government as the lead CRI in climate and weather hazards. We work closely with a number of other research agencies through the Natural Hazards Research Platform.

Our work includes:

- determining the frequency and magnitude of natural hazards
- estimating risk
- forecasting hazards by using integrated tools and modelling
- assembling research outcomes into meaningful and helpful outputs for end users.

niwa.co.nz/our-science/natural-hazards

Te Kūwaha — National Centre for Māori Environmental Research

NIWA's goal is to share knowledge and empower Māori communities and businesses with leading-edge science. We undertake research and provide consultancy services across a number of core science areas, including aquaculture, freshwater, marine, natural hazards, climate and energy.

Our work includes:

- providing environmental research of benefit to Māori through the formation of strong and meaningful partnerships with iwi, hapū and Māori organisations
- collaborating with Māori, other research providers, and central and local government agencies to identify and respond to Māori research priorities
- developing a distinctive body of knowledge at the interface between indigenous knowledge and research, science and technology
- increasing our Māori research capacity and awareness within NIWA of tikanga and te reo Māori.

niwa.co.nz/our-science/te-kuwaha

Pacific Rim

NIWA has a long history of providing applied science and environmental consultancy services to support international development activities, with a particular focus on the Pacific and Asia regions.

Our expertise and capabilities cover a wide range of applied science-based assistance to support the sustainable management of marine and freshwater resources and environments, increasing community and economic resilience to natural hazards, and understanding and adapting to the impacts of climate extremes, variability and change.

niwa.co.nz/our-science/pacific-rim

Vessels

NIWA's vessels are world-class environmental monitoring and research platforms. They enable our marine scientists, specialists from partner research organisations and commercial clients to carry out work where the need for knowledge is greatest – no matter how remote or inhospitable the environment may be.

Tangaroa, our flagship deepwater research vessel, is ice-strengthened and New Zealand's only DP2-equipped vessel. DP2, an advanced dynamic positioning system, enables the vessel to remain stationary or follow a precise path even in strong winds and rough seas. *Tangaroa* is also equipped with a range of sophisticated equipment enabling us to explore from sea surface to seabed and expand our understanding of our unique marine environment and its resources. A wide range of inshore and coastal research is made possible by *Kaharoa*, *Ikatere* and *Pelorus* to assist in coastal resource management.

niwa.co.nz/our-science/vessels

OUTCOME

1

Increase economic growth through the sustainable management and use of aquatic resources


Malcolm Francis

'Growing the regions' – increasing aquaculture in Marlborough Sounds and Northland

The Government's Regional Growth Programme is aimed at identifying economic opportunities in selected regions around the country – recognising that each region has the potential to attract further investment, raise incomes and increase employment opportunities.

In Northland, NIWA is taking a collaborative approach to harnessing economic opportunities from finfish aquaculture, working with Enterprise Northland and the Ministry for Primary Industries (MPI).

NIWA plans to invest about $24 million of Core Funding over the next five years in aquaculture development and to transfer that knowledge to the industry.

Reports received by NIWA and its collaborators support market demand for kingfish, with projections suggesting a kingfish farming industry could earn Northland more than $250 million annually.

MPI has set a goal of 25,000–200,000 tonnes annual production for Chinook salmon, yellowtail kingfish and hāpuku. From its state-of-the-art Northland Marine Research Centre at Bream Bay, NIWA has been contributing to the regional growth study, one component of which is to look at setting up commercial finfish aquaculture in Northland.

Agreement has now been reached to seek proposals for a schematic design of a land-based kingfish farm. This design work will provide clarity to the physical footprint, capital requirements, operating costs and production expected from a 500 tonne per annum unit.

NIWA's science seeks to provide that investment climate by determining suitable marine space and developing proven production technologies that can provide both profitable returns and a low environmental footprint.

While start-up aquaculture businesses are high risk, it is hoped that the first commercial trial for finfish will be underway by July next year.

Meanwhile, shellfish production continues to be a key component of New Zealand aquaculture, with mussel production comprising about two-thirds of the industry. NIWA scientists are looking at better understanding environmental factors affecting mussel farms and how farmers can maximise efficiency.

Climate variability is posing challenges to the industry and affecting mussel size at harvest. NIWA is working on forecasting that variability and predicting the attributes of mussels so they can be directed to the markets where they will achieve most profitability.

NIWA also continues to provide expert environmental evidence to regulatory authorities on the expansion of mussel and fish farming activities. In Marlborough, biophysical modelling work has revealed that current expansion projects are not large enough to cause the Sounds to be deemed eutrophic.

This is a significant finding that is helping guide Marlborough District Council and industry decision making associated with aquaculture development in the Sounds.

Kingfish at NIWA's Northland Marine Research Centre.

Applying weather and climate forecasting capabilities for improved primary sector performance

New Zealand's primary sector generates more than $30 billion in export earnings each year, and the Government has set an ambitious target of doubling that figure by the year 2025.

The Minister for Primary Industries identifies technological innovation, investment, market development and improved workforce skills as keys to achieving that aim, but the challenges are significant. Prominent among them is New Zealand's variable and often volatile weather.

NIWA is collaborating with a number of high-profile sector players to apply its high-resolution weather and climate forecasting capabilities in ways that will lead to improved farm efficiency and productivity, and thus profitability.

In 2014, NIWA established a strategic partnership with farmer-owned fertiliser cooperative Ballance Agri-nutrients. Ballance's online farm-management and information portal, Ag Hub, gives members direct access to FarmMet, a NIWA tool that delivers highly localised weather forecasts, climate summaries and other important environmental information to farmers' computers.

FarmMet can quantifiably improve operational decision making by farm managers, aiding decisions like when to sow, harvest, move stock, make hay, or protect against potentially damaging weather like frosts, floods and high winds. To further improve this service, NIWA plans to deploy up to 100 new climate stations on farms at locations that are not well served with weather and environmental data.

At National Fieldays in June 2015, NIWA introduced IrriMet, another high-resolution decision-support tool. IrriMet uses on-farm weather and soil-moisture measurements, or data from nearby climate stations, to advise farmers whether or not to irrigate or apply fertiliser during the next six days. It uses simple 'stop, go, wait' indicators to translate highly complex forecast outputs from NIWA's supercomputer into at-a-glance guides that help farmers maximise their productivity and minimise their impact on the environment.

NIWA is now working with 50 farmers in a trial to test the efficacy and functionality of IrriMet. The product will officially launch once feedback has been collated and refinements – where necessary – have been made.

Such partnerships are the outcome of a continued drive by NIWA to engage with the primary sector to find ways of adding value, utilising real-time weather observations, high-resolution weather forecasts, decades of high-quality climate data, a Virtual Climate Station Network (VCSN) and the computational power of the NIWA supercomputer.

Work has begun on several other online tools aimed at supporting different areas of the sector.

Helping ensure sustainable fisheries

Every year from 1992 to 2014 NIWA's deepwater research vessel *Tangaroa* has carried out surveys on the Chatham Rise to provide population estimates of hoki and other commercially important species, such as hake and ling.

During these surveys, NIWA scientists have also been able to study other aspects of deepwater biodiversity on the Chatham Rise, which has resulted in a wealth of information on changes to all major fish caught by bottom trawls in the region.

Since the surveys began, scientists have recorded a total of 558 species or species groups and analysed more than one million individual fish, squid, crustaceans, and benthic fauna. This information is now being used to assess how marine life on the Chatham Rise is faring.

A new study by NIWA scientists, undertaken for the Ministry for the Environment, has analysed the data from the surveys carried out between 1992 and 2014, to provide information on changes to marine ecosystems associated with fishing and climate change.

The Chatham Rise – about 800km long and 200km wide extending east from New Zealand to the Chatham Islands and beyond into the southwest Pacific – is also one of our most productive and important commercial fishing areas, providing about 60% of New Zealand's total fish catch. Regular monitoring to pick up any changes is essential to ensure New Zealand can maintain its sustainable fisheries management regime.

This new study calculated the Marine Trophic Index (MTI) – a widely-used indicator for monitoring changes in marine ecosystems – for bottom-feeding fish. Trophic levels identify the position of an organism within a foodweb, and range from one, for phytoplankton, to more than five, for apex predators such as killer whales.

Measurements of the stable isotopic composition of nitrogen from almost 1000 tissue samples were used to estimate trophic levels of 49 species of fish.

The study findings are due to be released on 21 October, as part of Environment Aotearoa 2015 – a series of reports being compiled by the Ministry for the Environment and Statistics New Zealand setting out why, where and how New Zealand's environment is changing and what impact that is having.

This research is unique in providing New Zealand with the opportunity to assess the state and management of our marine estate and helping meet management obligations for our Exclusive Economic Zone.

Enhancing the value of New Zealand's marine resources

One of the pillars of the Government's goals to enhance economic prosperity is the continued development of the energy and minerals sector. The oil and gas sector is one of New Zealand's largest export industries, contributing several billion dollars to our GDP each year.

NIWA has a long, established record of working with the major marine exploratory companies, both in New Zealand and further afield. For the oil and gas industry NIWA uses its scientific expertise, local knowledge and state-of-the-art equipment to conduct screening surveys that provide as much preliminary subsea information as possible to inform the next stage of exploration activity.

NIWA's new $1 million sub-bottom profiler, recently fitted to the hull of its deepwater research vessel *Tangaroa*, is a critical piece of equipment in the provision of these services. It is used to identify and help characterise marine sediments and strata, sometimes up to 200m below the surface of the seabed. This can help identify subsurface gas hydrates, which on the surface of the seabed can also be indicated by carbonate accumulations, hydrocarbon or methane-based seeps and gas chimneys.

The frontier exploration packages that NIWA provides to the industry use cutting-edge science to enable several tiers of sub-bottom profiler and multibeam echosounder data collected on *Tangaroa* to be analysed together by marine geologists.

In addition, the multibeam echosounder can also help locate plumes of escaping methane or hydrocarbon-based gas seeps within the water column. These plumes, many of which we are discovering for the first time, can be direct indicators of deeper seated hydrocarbon resources. On top of that, various tiers of environmental data can be collected and differing seafloor habitats identified, such as the exciting discovery of chemosynthetic communities.

In the past year NIWA has explored a large area of New Zealand's sea floor for the first time. This information, plus other data, enables the industry to make commitments of potentially hundreds of millions of dollars for exploration and development in New Zealand.

Once resource potential has been established, the focus of research then turns to establishing baseline surveys, habitat assessments and oceanography to better understand the ecology, chemistry and ocean physics of the areas.

Such information is essential for consents and is used to make decisions about resource suitability, sustainability and potential environmental effects.

This holistic approach to surveys of mineral and petroleum resources puts NIWA at the forefront of the science required for sustainable marine resource use.

OUTCOME

2

Grow renewable energy production through developing a greater understanding of renewable aquatic and atmospheric energy resources


Meridian Energy

Collaborative management of Waitaki hydro scheme aquatic weed threat

The South Island's Waitaki hydro scheme accounts for approximately one-third of New Zealand's hydro-generation capacity. Its eight power stations are crucial to the maintenance of a reliable nationwide electricity supply to homes and businesses.

The scheme and associated water bodies are vulnerable to aquatic weed invasion, which can create problems for electricity generation and inhibit use by a range of other stakeholders. Early detection greatly improves the chances of weed eradication or the successful implementation of control measures.

During the year, NIWA was contracted by Land Information New Zealand and their biosecurity service partner, Boffa Miskell, to conduct regular inspections of the lagarosiphon control works in Lake Benmore, and contribute to the preparation of an ongoing control programme. NIWA has also been tasked with preparing a 10-year management plan for lagarosiphon in the Waitaki catchment, on behalf of the wider stakeholder group.

NIWA had previously developed a plan that prioritises sites and frequency of surveillance within each waterbody in the Waitaki catchment. That plan forms the basis of the catchment-wide aquatic weed surveillance programme undertaken annually by NIWA.

The work is commissioned jointly by Meridian Energy, Environment Canterbury, and Genesis Energy, and is a first of its kind – ensuring a coordinated approach to aquatic weed surveillance strategies in the catchment for the benefit of all lake managers and users.

Sediment in our hydro lakes

For the past 20 years NIWA has been working with Contact Energy to monitor and develop strategies for managing sediment flowing into hydro reservoirs Lake Roxburgh and Lake Dunstan and to reduce flood risk caused by sediment deposited in Lake Roxburgh.

Roxburgh was formed in 1956 with the commissioning of Roxburgh Dam. Before the Clyde Dam was commissioned in 1992, forming Lake Dunstan, an average of 1.96 million tons of sediment per year was trapped in the Lake Roxburgh reservoir, of which about 80% was sourced from the Shotover River.

This has resulted in the formation of a large delta deposit that extends from the upper reaches of Lake Roxburgh to within 5km of the Roxburgh Dam. This large sediment deposit has raised the water levels and hence flood risk at Alexandra, which is at the upstream end of the lake.

Contact Energy operates a flood drawdown strategy which involves drawing down the reservoir water level during moderate flood events to accelerate flows and promote erosion of the sediment delta.

The aim is to use the erosive power of the flood water to move sediment from the top of the delta further downstream into deeper water or, in the case of very fine sediment, through the dam and on down the Clutha River.

NIWA's hydrodynamics engineers helped Contact Energy develop the flood drawdown strategy by modelling bed erosion under different scenarios, using a one-dimensional hydraulic/sediment model. Comparing model outputs enabled them to make an informed choice on the relative merits of the various alternatives.

Sediment models have now been set up for both of the Clutha hydro reservoirs. The latest model being used routes sediment mixtures with grain sizes ranging from clay through to fine gravel, evolves the composition of the reservoir bed sediment as deposition or erosion proceeds, and reproduces processes such as armouring of the reservoir bed surface caused by the selective winnowing of finer-grained sediment.

Model results have been validated in terms of bed elevation change, deposited sediment volume, and surface grain-size by comparison with results derived from regular field surveys of the lake bed and from field surveys of its sediment composition.

NIWA engineers continue to assist Contact Energy with sediment modelling studies to help explore sediment management strategies for both hydro-reservoirs.

OUTCOME

3

Increase the resilience of New Zealand and South-West Pacific islands to tsunami and weather and climate hazards, including drought, floods and sea-level change

Justin Watene

Managing coastal zone assets

New Zealand's National Coastal Policy Statement, administered by the Department of Conservation, requires local authorities to have policies in place to promote the sustainable management of natural and physical coastal resources.

These policies must identify areas at risk from coastal hazards, such as storm inundation and climate change, for the next 100 years, as future sea-level rise and high storm-tides are expected to dramatically increase the impact of flooding and property damage.

NIWA scientists have been at the forefront of advising a growing number of councils on the effects of climate change and storm tides that are informing development and infrastructure decisions.

In Auckland, NIWA has been providing this expertise for the council's planned upgrade of the Northwestern Motorway and the new Waterview tunnel link from SH20.

The Causeway upgrade is a 4.5km-long project between the Great North Rd Interchange and the Te Atatu interchange, and a key component in completing the Western Ring Route road of national significance project. It is also New Zealand's largest roading project.

Long-term subsidence of the Causeway across Waterview Inlet has resulted in extremely high spring tides that are increasingly flooding the road and cycle lanes. NIWA has been involved at the feasibility stage of the upgrade. During the coastal engineering design phase it provided numerical modeling of waves and storm-tide hazards for the Causeway and advised on the effects of climate change, including sea-level rise.

Rob Bell

On Auckland's Southern Motorway at the Puhinui Inlet, just north of Papakura, NIWA has also carried out similar modelling known as the joint-probability method to inform decision making over increasing the width of the causeway across the inlet.

This method, which combines assessment of coastal-storm inundation and the effects of sea-level rise, has provided a robust and flexible framework that stood up well to scrutiny during the hearing process of the Proposed Auckland Unitary Plan.

Other councils, including Tasman, Gisborne, Nelson, Bay of Plenty and Canterbury have used NIWA's expertise in this area to help determine coastal development and infrastructure rules.

With the National Coastal Policy Statement requiring councils to take into account the best available information on the likely effects of climate change on their region, NIWA is at the forefront of helping protect our future coastal development from flooding and damage.

King tide on Auckland's Northwestern Motorway.

Improved productivity and risk mitigation through enhanced environmental forecasting

Shipping movements and onshore operations at South Port are significantly affected by weather conditions – in particular wind. Sustained winds or gusts of a particular strength can reduce the efficiency of vessel loading and unloading, blow over container stacks, and affect the port's customers through delays, damaged goods and subsequent insurance claims.

For several years, NIWA has provided tailored weather forecasting services to South Port to support operational decision making and risk management. NIWA delivers regular, location-specific forecasts direct to the port's operations management team. The forecasts are adjusted and validated using weather readings from a monitoring station located within the harbour area.

This year, South Port and its customers have benefited from a number of key enhancements that NIWA has made to the scope, efficiency and effectiveness of its forecasting systems.

Forecasts are now available just six minutes after NIWA's computer model completes its run (previously the delay was 90 minutes). There have been significant improvements in forecast system accuracy and range, alongside major improvements to forecast resolution. The global model that NIWA uses is now forecasting at a resolution of 17km (previously 120km), while NIWA's own NZCSM model is forecasting at an industry-leading resolution of 1.5km (previously 12km).

South Port's operations team confirms that these improvements have helped them to adjust and lift the efficiency of their cargo-handling operations.

Ongoing consultation between NIWA and South Port is also paying dividends. The South Port team recently advised that, while the timing of NIWA's wind forecasts was very good, a tendency to sometimes under-forecast gust intensity was creating risk-management challenges. NIWA responded with port-specific wind-gust forecasts, adjusted and validated using observations from the monitoring station located right in the heart of the operational area.

The enhancements to forecasting capability and accuracy that NIWA has implemented are helping a range of other industries to better manage weather- and climate-related risk.

Jeremy Pierce

NIWA's service to the National Rural Fire Authority, for example, has recently been expanded to incorporate hourly observation and forecast outputs, greatly enhancing the precision with which regional fire managers can monitor fire risk, marshal firefighting resources and inform the public. In addition, ongoing consultation with the primary sector has resulted in the development of a range of online, location-specific forecasting tools designed to help different players in the sector make informed operational and risk-management decisions.

Mark Brimblecombe

Forecasting floods

Just as scientists are predicting climate change will bring more rain in parts of New Zealand, NIWA has vastly improved its capability to forecast floods of waterways.

The key has been the linking this year of a higher resolution weather model and a river flow prediction model. Combined, the two can provide a far more accurate and timely warning of river flows than has yet been possible.

NIWA has started running an upgraded weather model which represents New Zealand in 1.5km blocks. This feeds into a refined water flow model called TopNet, which models the fall, storage and transfer of rain across a catchment.

The TopNet model accounts for all the major factors affecting how much water moves into waterways, and its rate. The improved representation of real-life water flow across topographically accurate catchments, means TopNet is now much better at forecasting the timing, volume and height of water in waterways.

Improved rain forecasting in terms of volume, timing and location, provides better water data for TopNet. NIWA's weather predictions from 1.5km blocks, rather than the previous 12km, gives localised inputs. This degree of resolution allows storm systems and interactions of weather fronts and mountains to be more precisely modeled, increasing the accuracy of the total volume of rain forecast fall in each catchment.

Armed with that knowledge, and their awareness of bank and floodplain heights, local authorities can be well equipped to assess the likelihood of flood damage and potential losses.

TopNet is also being fine-tuned to specific catchments. NIWA's flow prediction model uses a unique method that feeds real-time measured river flow observations back into the model. This corrects the model on-the-fly to improve future forecasts, and ensures that errors in rainfall forecasts don't accumulate in the model. Historic weather data can be directed into the model, to identify areas where predicted river flows differ from actual river flows measured on the ground.

NIWA is working with the West Coast Regional Council in an Envirolink-funded project to forecast flow and volume in the Buller and Grey Rivers. Armed with river flows forecast from 1 to 36 hours ahead of the rain actually making it into the rivers, the council will be able to judge the likelihood of floods and make plans accordingly.

The project will progressively tweak the model to better represent what happens in the catchments feeding the Buller and Grey Rivers.

TopNet is simultaneously being tuned by another NIWA project to forecast river flows and floods, decades and even millennia into the future. A team working on regional climate models estimating future climates is modifying them to provide data for hydrological models that generate future water flow predictions across New Zealand.

RiskScape

RiskScape, a joint venture between GNS Science and NIWA, is a tool for analysing potential economic and human impacts and losses from multiple natural hazards. It can be used to balance the cost of protection measures (such as flood defences, earthquake strengthening or insurance cover) against losses.

Designed for use by not-for-profit and local and central government agencies, RiskScape has undergone significant transformation in the past year, with efforts focused on implementing a new website and interface redesign.

In addition to the redesign, the World Bank has named RiskScape as one of the best available platforms of its type, distinguishing the package as "one of the most user-friendly" available. "RiskScape was very easy to run, with all models tested inside a few minutes. The user interface is great."

A full inventory of all formal buildings in New Zealand has been completed and built into the RiskScape system, allowing it to convert asset and hazard information into likely impacts on a locality or region. It is able to model building damage and replacement costs, human casualties, economic losses, business disruption, and the numbers of people injured and displaced based on a range of possible hazard situations – earthquakes, flooding, tsunami, volcanic ash fall, windstorm, coastal storm-tide inundation.

The range of natural hazards featured in RiskScape is being expanded to include landslides and snow storms (among others).

Work has also continued on updating datasets, with hazard and asset modules able to be developed in any major projected or geographic coordinate system. Natural hazard exposure models and asset inventories, developed specifically for RiskScape, also save time and money spent on developing these datasets for asset impact and loss modelling in New Zealand.

RiskScape has also been deployed overseas in the past year, completing river flood modeling in Nadi in Fiji and sea-level rise and flood modeling in Port Vila and Luganville in Vanuatu.

Helping the Pacific nations manage risk and resources

NIWA plays an important role in the Pacific – developing capacity and tools to help Pacific island nations prepare for, and build resilience to, extreme weather events and climate change, as well as improving economic development through sustainable use of natural resources.

NIWA's approach has been to adapt its science to the needs of Pacific communities, transferring knowledge that encourages and empowers communities to be part of long-term solutions.

A series of tools have been successfully deployed to support infrastructure planning, and they are now being used to guide and inform development in Kiribati, Fiji and the Cook Islands.

In recent years Fiji has started to address the flood risk and development challenges facing Nadi, with a number of inter-related projects aimed at reducing the impacts. NIWA has been part of this effort, initially establishing a network of rain gauges and river flow monitoring stations in the Nadi catchment which transmit data back to the Fiji Meteorological Service to form part of an early warning system. NIWA also completed the Nadi River Flood Risk Project with the Geoscience Division of the Secretariat of the Pacific Community, with funding from the World Bank.

NIWA used computer modeling to assess flood events in the Nadi river catchment, including simulating the 2012 flood. Increasing urban population growth and development of land within floodplain areas had exacerbated the risk of flood disasters. Using topographic data from high-resolution LiDAR (airborne laser scanning), hydraulic inundation models (computer flow simulations) and risk models (combining hazards and assets), NIWA developed flood inundation maps, from which economic damages and human losses for the Nadi flood plain area could be calculated.

The flood model information is now being used in a subsequent NIWA-led project, funded by the Asian Development Bank and working with Nadi Town Council and the Department of Town and Country Planning within the Fiji Ministry of Local Government, Housing and Environment to develop tools and processes to better integrate risk considerations into urban and infrastructure planning.

Graeme Smart

Limited freshwater resources in low-lying islands in particular are under extreme pressure from population growth and poor management, as well as rising sea levels and other impacts of climate change.

In Fiji, NIWA is involved with two projects installing community-based waste treatment solutions to protect public health and reduce contamination of coastal waters.

In Kiribati, NIWA is involved in a two-year project to establish baseline water quality reporting, resulting in a colour-coded report providing key information to inform and prioritise water and sanitation infrastructure investment decisions.

This work in Kiribati built on previous NIWA activities with the Cook Islands Ministry of Marine Resources to develop their water quality testing capabilities. Development of this capacity has now enabled the Ministry of Marine Resources to directly provide the water quality monitoring services to Infrastructure Cook Islands during the implementation of the 4-year Sanitation Upgrade Programme.

Another NIWA achievement in Fiji was a climate services software upgrade, for the Fiji Meteorological Service (FMS). A Fire Weather Index system and new drought monitoring software was installed, and other software fine-tuned in consultation with FMS climate staff, with NIWA conducting training workshops for about 15 FMS staff.

Water monitoring projects in Fiji were also completed, with NIWA now providing reliable rainfall information from the catchments that supply the water for Fiji Water's bottling operation, and in the catchments that feed the 42MW Nadarivatu Hydropower Station.

Meanwhile, NIWA's development of a Climate Early Warning Service with the Samoa Meteorological Service was acknowledged by the Secretary General of the World Meteorological Organization, Michel Jarraud.

He said "Samoa is at the leading edge for the development of climate services for Small Island Developing States. When people ask me 'What can we do with the Global Framework for Climate Services?' I can say, 'We can refer to the experience and developments in Samoa'."

OUTCOME

4

Enable New Zealanders to adapt to the impacts and exploit the opportunities of climate variability and change and mitigate changes in atmospheric composition from greenhouse gases and air pollutants


Petr Horálek

International valuing of NIWA's research

NIWA's world-renowned climate and ozone research received further recognition in the past year, cementing the importance of its Lauder Atmospheric Research Station to national and international research.

In March, Lauder became the fourth upper-air site in the world to be certified by the World Meteorological Organization with official Global Climate Observing System (GCOS) Reference Upper Air Network (GRUAN) status.

Lauder joins sites in Germany, Norway, Switzerland and the US where GRUAN measurements serve as the gold standard for validating satellite data as well as being high quality references for regional upper-air meteorological stations.

The best practices used in GRUAN-certified measurements, including traceable calibrations and uncertainty estimates, serve as exemplars for the meteorological community.

Stable, standardised and well-calibrated atmospheric observations are crucial to documenting climate and climate change. GRUAN certification is a significant endorsement of Lauder's capabilities as a world-class upper-air sounding site.

Lauder also achieved another milestone during the year with the 30th anniversary of the first MIR-FTIR (mid-infrared Fourier Transform Infrared Spectroscopy) measurements.

The work pre-dates the internationally important NDACC (Network for the Detection of Atmospheric Composition Change) of which NIWA is a member. The MIR-FTIR measurements are critical for understanding atmospheric processes and change.


Petr Horálek

In September, another milestone was reached when the Total Carbon Column Observing Network station at Lauder provided validation data for NASA's Orbiting Carbon Observatory-2 for the first time. The satellite, travelling at 7.5km per second, took 9 minutes 21 seconds to cross the Central Otago sky.

Lauder has been part of the Total Carbon Column Observing Network for just over a decade, and during that time the site has evolved through a number of high resolution Fourier transform spectrometers to achieve the high precision and data integrity required for satellite validation activities.

The Orbiting Carbon Observatory-2 and the Total Carbon Column Observing Network provide global measurements of the sources, sinks and variability of the greenhouse gases for climate change studies and to inform emissions policy.

Water quality in the Firth of Thames

NIWA has produced an in-depth and extensive report on water quality in the Firth of Thames, drawing on data collected primarily by NIWA over two decades, and working closely with Waikato Regional Council and DairyNZ.

The Firth of Thames Water Quality and Ecosystem Health synthesis report was commissioned in response to questions raised by Waikato Regional Council and DairyNZ relating to sediments, nutrients, phytoplankton/bacteria, dissolved oxygen and pH (acidification).

The aim of the report was to assess the state and trends in water quality and ecological health of the Firth of Thames. It also identified information gaps and recommended priorities for future work that would enable more comprehensive future assessments. It was complemented by another report describing the data that NIWA had collected in the Firth of Thames and Hauraki Gulf during the past 20 years.

The report has allowed researchers to draw conclusions over the Firth's current water quality and ecosystem health status and trends – better informing thinking about its future.

It found that fine sediments in the Firth were largely the legacy of past human activities, resulting in limited opportunities to mitigate sediment effects. It concluded that, even if catchment sediment inputs could be turned off, the prospects for a natural recovery of the benthic ecosystem to a pre-reef-collapse state was unlikely.

The report also found that the Firth and extended Firth were sensitive to nutrient enrichment, which means that symptoms of eutrophication are less likely to be suppressed by physical factors (such as turbid water/low light, short water residence time, and strong vertical mixing of the water column).

The Firth and extended Firth are now mesotrophic – meaning it is capable of a moderate or intermediate amount of


NASA

productivity. The report finds that the area would have been less mesotrophic before catchment deforestation and subsequent development.

Although the Firth of Thames is a closely studied body of water, the report's unusually long-term approach provides information on long-term trends and is, in that respect, unique and especially valuable. This information is directly relevant to the Waikato Regional Council's review of its regional coastal plan, and over the long term plan changes to address freshwater quality.


Dave Allen

NIWA a consortium member of the Unified Model

The benefits of a Core Funding system for Crown Research Institutes have been clearly demonstrated in the past year, enabling NIWA to access intellectual property that offers huge dividends for New Zealand.

Core Funding provides funding certainty which has seen NIWA's long-standing relationship with the UK Met Office result in access to its weather and climate modelling suite – the Unified Model.

Internationally, the Unified Model is fast becoming the model of choice for forecasters of weather and climate, including the US Air Force. It has a reputation as a world-leading, seamless, environmental modelling system.

NIWA has become a core member of the Unified Model Consortium (UMC), joining the UK Met Office, Korea Meteorological Administration, Australian Bureau of Meteorology, Commonwealth Scientific and Industrial Research Organisation, and the Ministry of Earth Sciences (India) – providing access to billions of dollars of international IP.

The Unified Model now underpins NIWA's operational environmental forecasting system (EcoConnect), and is crucial to the issues being addressed through the *Deep South* National Science Challenge. As a result, NIWA's forecasting capabilities are world class.

One of the requirements of UMC membership is the ability to contribute to its development, something NIWA has been able to achieve through investing in its high-performance computing and staff.

Modern environmental prediction systems use complex workflows and have many inter-dependent tasks distributed across multiple computers in a high-performance computing environment. These range from earth systems models focused on climate timescales, to numerical weather prediction and weather-driven sea state, storm surge, and flood prediction models.

To support robust automation of complex distributed cycling workflows in hazards' research and operations, NIWA used Core Funding to develop the Cylc suite engine. Cylc is built on a novel metascheduling algorithm, has a powerful workflow definition format, and advanced catch-up and error recovery capability.

Cylc now underlies all numerical weather prediction research and operations at NIWA and the UK Met Office, and is the recommended metascheduler of UMC members. It is also used by other groups internationally, such as the Max Planck Institute for Meteorology in Hamburg, and the Marine Meteorology Division of the Naval Research Laboratory in Monterey for hurricane forecasting. Cylc is now the pre-eminent tool for managing environmental modeling systems on some of the largest supercomputers in the world.

Practically, membership of the UMC provides NIWA scientists access to billions of dollars of intellectual property, including the latest versions of the modeling software and related tools. It also offers the opportunity to collaborate with world-leading researchers in weather and climate science and direct input into, and benefit from, a global research effort that addresses one of the most significant threats facing the planet – global climate change.

OUTCOME

5

Enhance the stewardship of New Zealand's freshwater and marine ecosystems and biodiversity

Dave Allen

Tracking and managing sediment pollution

NIWA's compound specific stable isotope (CSSI) technique made a considerable impact during an Environment Court hearing recently, when it was endorsed as a tool for consent compliance monitoring of sediment sources.

This is a precedent for the application of the CSSI technique in Resource Management Act-related processes, and further endorsement that NIWA is leading science for managing sediment sources.

The CSSI technique, now well-established nationally and internationally, tracks where sediment originates within catchments – where traditional geological techniques are often ineffective.

While sedimentation is a natural process, activities such as deforestation, heavy grazing and changes in land use can accelerate soil erosion and degrade water quality in lakes, reservoirs and floodplains.

Soil erosion can have serious impacts on land, such as reduction in effective soil depth and water storage capacity, loss of fertility and reduced crop production. Downstream, the impacts can be catastrophic, with major economic and environmental impacts on rivers, wetlands, estuaries and coastal waters.

Working out where most of the sediment originates, and how much is being produced, is critical to making informed sustainable management decisions that cost-effectively target the main sources.

Plant communities growing on land define the land use. The plant communities produce substantial amounts of organic compounds that can bind to the soil and add to the soil characteristics for that land use. Consequently, some of these organic compounds can be used as biomarkers or 'fingerprints' to identify that land use in a sediment mixture in a deposition zone. Analysis can extract those fingerprint characteristics from the sediment mixture, and the fingerprints can then be compared with a library of known soil fingerprints to identify and apportion the sources of soil contributing to the sediment.

The forensic nature of the CSSI technique can identify 'hot spots' and apportion the land uses within an area that are contributing to the eroded sediment.

Comparisons can also be made at regular intervals to test whether management plans have been effective.

Earlier this year in Northland, NIWA scientists presented the results of a sediment sources study to regional council staff and managers and community groups. The study showed the CCSI method in action, finding that soil erosion in the upper Waitangi catchment is dominated by erosion of subsoils from degraded pasture. Meanwhile, dairy pasture was found to be the largest contributor of soil eroded in the Waiaruhe sub-catchment.

In the lower Waitangi catchment, erosion of river banks was a major source.

Based on these findings, the Northland Regional Council is in the process of developing an action plan, and it is likely that the CSSI technique will be used to study other Northland catchments.

Helping with biosecurity concerns

In mid-February this year a single male Queensland fruit fly was found in the Auckland suburb of Grey Lynn, in a surveillance trap monitored by the Ministry for Primary Industries (MPI).

The find immediately triggered biosecurity measures, including setting up a containment zone and NIWA installing an emergency response electronic weather station at nearby Chamberlain Park.

The fruit fly, an Australian native, is known as the 'foot and mouth' of the horticultural industry. It is extremely difficult to eradicate, and has the potential to severely disrupt New Zealand's $2.6 billion horticulture export trade and lead to greater trade barriers for exporters.

NIWA has two emergency weather stations on standby to respond to biosecurity alerts, and in this case also supplied retrospective meteorological data to help determine how long the fruit fly might have been present.

The fruit fly's life cycle is heavily dependent on climatic conditions, so temperature and humidity data help in determining when the eggs are hatching and what generation they are.

NIWA also supplied data on soil temperature and moisture content, which were higher than MPI expected, which meant officials were able to re-determine life-cycle calculations. This information is also used for dispersion modelling and trajectory analysis to track fruit fly movement.

NIWA works closely with MPI on biosecurity issues and is also poised to respond in the event of a foot and mouth outbreak. Weather information provided by NIWA in real time can assist in understanding the spread of foot and mouth outbreaks. This information can be supplied within three hours of an outbreak being confirmed.

James Niland

The work complements NIWA's biosecurity efforts in assessing the risks pose by potential aquatic weeds and in identifying marine pests at New Zealand ports.

More than a dozen fruit flies and fruit fly larvae were found in Grey Lynn and NIWA continues to provide MPI with weather advice in relation to the discovery, including a weekly 15-day forecast.

Dave Allen

Helping councils with water accounting

Over the past few years, the conflicting values and uses that humans have for freshwater are bringing freshwater management issues into sharper focus.

On 1 August last year, the National Policy Statement for Freshwater Management 2014 (NPS-FM) came into effect.

The NPS-FM makes it mandatory for councils to set objectives and limits on resource use in plans, outlines responsibility for water quantity and quality, and adds requirements to use a new 'national objectives framework' to help set objectives and limits. It also introduces the specific requirement to account for all freshwater takes and sources of freshwater contaminants.

As part of the Resource Management Act, the addition of the NPS-FM means councils have many factors to manage.

The amended NPS-FM requires councils to establish accounting systems for freshwater quality and quantity in locations (called Freshwater Management Units) where decisions on freshwater management practices are being made.

The Ministry for the Environment undertook to issue guidance to help regional councils implement the NPS-FM in their region.

Acknowledging that time would be required to achieve this, each region will develop a process that works for their physical systems (how much water they have, where, and what it is used for) and their communities.

The first of these guides was in freshwater accounting, and the Ministry turned to a NIWA-led team to help create the guide.

Water accounting is a vital part of good water management. As is the case in financial matters, where monitoring of incomings and outgoings is vital to guard against going into overdraft, regional freshwater objectives and limits rely on accurate knowledge of the inputs and outputs of waterways.

Within a freshwater quantity accounting system, all water taken from the water body must be quantified.

Similarly, a freshwater quality accounting system requires quantification of all contaminants that are being discharged into freshwater. This includes both point sources and diffuse sources of contaminants.

There is no single correct or preferred way to establish a freshwater accounting system to meet the requirements of the NPS-FM. Each regional council will need a system that reflects the issues of the Freshwater Management Units for which the accounts are being generated. That makes it difficult to design a template system, so the guidance needed to allow for such flexibility.

The NIWA-led team developed a document that provides guidance on accounting requirements, key definitions and interpretations, and general principles for freshwater accounting, as well as specific advice on how to account for all water takes and all relevant sources of contaminants.

The team has made the guide pragmatic and user-friendly, working with several regional councils during the writing phase. It also included 22 real-world case studies to illustrate the techniques and principles involved.

The NIWA report has been turned into a formal guidance document, which has been open for feedback from all councils and other groups, such as the Land and Water Forum.

OUTCOME

6

Increase understanding of the Antarctic and the Southern Ocean climate, cryosphere, oceans and ecosystems and their longer-term impact on New Zealand


Brett Grant

Tracking responses to Antarctic environmental change

There is considerable global interest in predicting what sea ice at both poles will do over the next century. NIWA scientists are building a new collaboration with a multi-national group of researchers to explore the processes that underpin these predictions.

The focus of the collaboration is on the ocean's response to polynya. These ice-free areas of the coastal ocean are factories for sea ice and bottom water – the coldest, saltiest seawater on the planet. The collaboration is presently targeting the Terra Nova Bay polynya, about 300km north of Scott Base. This polynya forms in the lee of the Drygalski Ice Tongue, a giant floating glacier – at nearly 70km long, it is the largest floating glacier in Antarctica.

The NIWA team's interest lies in the preconditioning of the seawater. One of the many unique features of the ocean around Antarctica is that some of it lies beneath ice shelves. In a warming world, these ice shelves are melting, and the water is flowing from under the ice shelf more rapidly, resulting in a colder coastal ocean that feeds sea-ice growth.

As well as having strong national links with the Universities of Otago and Canterbury, NIWA works closely with Australia, Canada, the US, Italy and Korea, as part of the team brought together by the New Zealand Antarctic Research Institute in a formal research agreement with the Korean Polar Research Institute.


Brett Grant

In late 2014 the Korean icebreaker RV *Araon* deployed a sequence of NIWA's instrumented ocean moorings near the Drygalski Ice Tongue. These hold sensors through the water column to gather ocean current, temperature, salinity and oxygen data. The data recorded by these instruments are expected to allow the multi-national team to better understand how the polynya operates and the downstream effect it has on sea ice.

There are substantial benefits to working collaboratively with other countries. As science questions get bigger and bigger, it becomes even more vital to share intelligence, data, assets, platforms and facilities. Sea ice connects to everyday life in New Zealand through climate and weather processes as well as sea-level rise. Understanding what sea-ice coverage is likely to do in the future will help New Zealand prepare for future climate events.

Understanding Antarctic toothfish populations

The Ross Sea is one of the few remaining large marine ecosystems with a virtually intact range of top predators – whales, seals, seabirds, including penguins, and large predatory fish, such as toothfish. Toothfish are the top fish predator in the Ross Sea region, but they in turn are preyed upon by killer whales and Weddell seals.

A dramatic reduction in catch rates of Antarctic toothfish in McMurdo Sound after 2001 that was observed by some researchers led them to conclude that the commercial bottom longline fishery for toothfish in the Ross Sea had drastically altered the toothfish population in McMurdo Sound, with cascading effects on the ecosystem.

In 2014/15 NIWA conducted a pilot survey to better understand the top predators in McMurdo Sound. Their research aimed to map the distribution of toothfish, and assess their diet, age and abundance, while collaborators from the University of Canterbury did the same for Weddell seals and killer whales.

The research included drilling a series of holes through the sea ice – typically 2m thick – and using baited hooks to catch toothfish near the sea floor. Captured fish were tagged and released or retained for tissue samples.

The results clearly demonstrated that the toothfish population had not been decimated as had been suggested. Moreover, the fish were older than expected – with a median age of 24 years compared with a median age of 10 years in the southern Ross Sea – showing that these were not young fish just recruiting to McMurdo Sound.


Paul Ensor

The high-quality science outcomes of these research programmes enable New Zealand to take a leading role in the management of this valuable international fishery. The results will influence and support the sustainable management of the Antarctic toothfish fishery, which is overseen by the Commission for the Conservation of Antarctic Marine Living Resources – who had come under increasing attack from proponents of a no-take Marine Protected Area for the entire Ross Sea region.

Creating new knowledge of the Southern Ocean

In February–March 2015 NIWA's deepwater research vessel *Tangaroa* carried out a highly successful 42-day research voyage to the Ross Sea. The voyage of nearly 15,000 km provided substantial new understanding of the feeding grounds, distribution and behaviour of large cetaceans and toothfish.

The cetacean work of the NIWA and Australian Antarctic Division scientists focused primarily on the feeding areas of blue whales and humpback whales; the toothfish research was centred on the Ross Sea slope area, the main fishing ground for Ross Sea toothfish.

Antarctic blue whales were exploited to near-extinction by industrial whaling, but there are signs the population is recovering. Innovative passive acoustic monitoring technology was used to locate blue whales in the vastness of the Southern Ocean. Sonobuoys deployed from the ship provided bearings towards the source of the low frequency whale songs, even when the whales were hundreds of kilometres away. Once blue whale foraging 'hotspots' were identified, visual observers counted and photographed the whales for identification, and recorded behaviour. Over 520 hours of individual whale song recordings were made and more than 40,000 individual blue whale calls were detected. More than 80 individual blue whales were seen, and 58 were photo-identified.

A systematic survey was also carried out to study factors causing humpback whales to aggregate around the Balleny Islands, a known feeding area for the species. Detailed visual observations of the distribution of whales around the Balleny Islands were collected, in conjunction with acoustic recordings of krill density. Preliminary results show similar patterns in the distribution of humpback whales and Antarctic krill, with few whales seen around the southernmost Island (Sturge), where krill densities were lowest.

A trawl survey was carried out on the Ross Sea slope to provide estimates of the abundance and distribution of bottom-dwelling fish species to help better understand, predict and manage the ecological effects of commercial toothfish fishing in the Ross Sea region. A catch of 960kg was taken in 18 trawls, made up of more than 90 species or species groups of fish and invertebrates. The main groups caught included key toothfish prey species like grenadiers, icefish, and silverfish.

An echosounder was moored in Terra Nova Bay to observe potential silverfish migration and spawning. This will record under the sea ice during winter before being retrieved in January 2016. It is hoped the data will provide new information on the life history of this important prey species, at a time of year when they have never been studied previously.

Scientists also gathered valuable data to help monitor the Southern Ocean climate. Continuous measurements of oceanographic and atmospheric properties collected during the voyage will contribute to global datasets and models, to help improve weather forecasting and better understand the effects of climate change in the Southern Ocean.

Data from the voyage have already been presented to the International Whaling Commission and the Commission for the Conservation of Antarctic Marine Living Resources, and will form part of New Zealand's contribution to the Southern Ocean observing programme – an international effort to coordinate Southern Ocean observations.

The voyage was supported by funding from Antarctica New Zealand, the Ministry of Business, Innovation & Employment, the Australian Antarctic Division, and NIWA.

Hinrich Schaefer

BENEFITS OF CORE FUNDING

This section reports only on the Core-Funding component of the Statement of Corporate Intent (SCI) programmes, which have associated research (e.g., Ministry of Business, Innovation & Employment contestable projects) and stakeholder-funded activities (e.g., co-funding). The sector benefits column focuses on the Core-Funded element of the programme. Detailed descriptions of three key innovations in each Statement of Core Purpose (SCP) outcome area are given on pages 60–75.

Statement of Core Purpose outcomes

1. Increase economic growth through the sustainable management and use of aquatic resources.
2. Grow renewable energy production through developing a greater understanding of renewable aquatic and atmospheric energy resources.
3. Increase the resilience of New Zealand and South-West Pacific islands to tsunami and weather and climate hazards, including drought, floods and sea-level change.
4. Enable New Zealand to adapt to the impacts and exploit the opportunities of climate variability and change and mitigate changes in atmospheric composition from greenhouse gases and air pollutants.
5. Enhance the stewardship of New Zealand's freshwater and marine ecosystems and biodiversity.
6. Increase understanding of the Antarctic and Southern Ocean climate, cryosphere, oceans and ecosystems and their longer-term impact on New Zealand.

A NIWA scientist drilling an ice core on Taylor Glacier, Antarctica.

Aquaculture

MBIE priority area: Primary industry productivity and sustainability

SCI programme	Sector benefits	SCP outcome No.	Core Funding investment ($) Budget, 2014	Core Funding investment ($) Actual, 2014
Develop reliable and efficient techniques for commercial-scale production of established and emerging high-value aquaculture species	Production information and economic models enable robust investment decisions to be made by government and investors intending to commercialise finfish species. Research has resulted in measurable economic gains by existing industry. A key area of application is in Northland, where a multi-stakeholder collaborative approach is being taken to advance high-value finfish aquaculture in New Zealand.	1	2,020,000	2,516,000
Develop the underpinning science, monitoring tools and farm management systems that quantify and minimise the environmental effects of aquaculture while optimising production and minimising the risks to aquaculture from environmental stressors	Developed models and tools have become essential for government, regional councils and industry in the planning, siting and monitoring of marine farms, and have contributed to decision making in the Environment Court and in industry and management agencies. The programme is leading the development of provisional water-quality standards for the Marlborough Sounds, and contributing to the development of benthic standards that will enable environmentally sustainable finfish farming in the Marlborough Sounds.	1, 5	1,330,000	1,206,300
Develop fish breeding and genomic technologies and apply these to the development of elite stocks that provide the New Zealand industry with sustained competitive advantage	Production of elite broodstock that improves the growth performance of commercial stocks. Genetic information and genomic resources have been applied for multiple commercial species to improve efficiency and performance, resulting in improved economic metrics for existing industry and facilitating its future development. For example, combining a commercial breeding programme for one specific species with NIWA elite broodstock this year will result in significant gains for growth and a reduction in the time to harvest.	1	1,390,000	1,028,100

Fisheries

MBIE priority area: Primary industry productivity and sustainability

SCI programme	Sector benefits	SCP outcome No.	Core Funding investment ($) Budget, 2014	Core Funding investment ($) Actual, 2014
Develop and apply stock monitoring and assessment methodologies for New Zealand's fisheries to enable monitoring and prediction of changes in fish population biology, fish stock biomass, and size and age composition	Advice to stakeholders is based on state-of-the-art software and techniques to enable monitoring and prediction of changes in fish population biology, fish stock biomass, and size and age composition. New Zealand fisheries continue to be recognised internationally as sustainably managed, which brings enhanced market opportunities, and this programme is an important contributor to that recognition.	1	700,000	680,000
Develop and apply standardised methodologies to monitor and assess international fisheries outside the New Zealand EEZ and determine the environmental effects of fishing	Effective management and sustainability of the toothfish fishery in the Ross Sea region, which continues to be accredited.	1	30,000	50,000
Determine the impact of fisheries on the aquatic environment to inform an ecosystem-based approach to fisheries management and contribute to broader ecosystem-based management approaches in conjunction with the Coasts and Oceans Centre	Methods and tools are used to enable end-user engagement and collaboration on the development of management actions and simulations that will enhance the economic use of New Zealand's natural marine resources. A range of tools is used to efficiently deliver information to end users using both web-based and desktop computer tools, and helps improve management and enhance the economic benefit of living marine resources. This work aligns strongly with the *Sustainable Seas* National Science Challenge.	1, 5	750,000	750,000

Coasts and Oceans

MBIE priority areas: Marine resources and ecosystems; Mineral resources

SCI programme	Sector benefits	SCP outcome No.	Core Funding investment ($) Budget, 2014	Core Funding investment ($) Actual, 2014
Marine physical processes and resources: Characterisation of the marine geological and oceanic energy resources in New Zealand, the Ross Sea region and the Southern Ocean and the physical processes and environmental factors that affect those resources	Improved knowledge of the shape and composition of the seabed, and improved access by industry and government agencies to seafloor data, enables better management of the environment and utilisation of seabed resources. For example, the programme produced the first continuous semi-quantitative map of the distribution of seafloor sediment around New Zealand, which will inform a wide range of stakeholder habitat and resource mapping projects.	1, 5	1,900,000	1,899,500
Marine biological resources: Delivery of fundamental knowledge about the diversity and distribution of the marine biota in New Zealand's territorial waters, EEZ and Southern Ocean, over a variety of space- and time-scales	A greater understanding of the biological resources in New Zealand's marine estate – their biodiversity, distribution in space and time, and biological functioning and interdependencies. The programme covers a wide range of marine biota, including algae, invertebrates, fish, seabirds and whales. Knowledge of new taxa and the distributions of species is vital for many science programmes, and is an important component of decision making by central government agencies, commercial companies, regional government and others, particularly in relation to biodiversity and biosecurity management.	5, 6	1,790,000	1,833,800
Ocean flows and productivity: Definition of the spatial and temporal variation in New Zealand's ocean current flows, primary and secondary production, and determination of how biogeochemical and physical oceanographic processes influence biotic variability	The influence of physical, chemical and biological processes on marine community structure, function and production, together with critical time series of coastal and deeper ocean waters, allows natural variability to be separated from anthropogenic change (e.g., ocean acidification). Understanding and predicting such cumulative impacts allows stakeholders to define the environmental and biological constraints and manage activities to maximise marine resource use.	5, 6	1,740,000	1,782,000
Ecosystem structure and function: Determine the structure of marine ecosystems, the interactions amongst their components that affect ecosystem stability, and develop ecosystem models that can inform management of New Zealand's marine estate	Decision makers are able to consider multi-level interactions in marine food webs when managing human impacts such as fishing, habitat modification and pollution. Robust information on marine food-web dynamics is crucial to achieving the dual priorities of maximising economic growth while minimising risks to the long-term productivity of New Zealand's natural resources.	1, 5, 6	990,000	827,000
Managing marine ecosystems: Determine the characteristics and vulnerability of marine communities, habitats and ecosystems by linking knowledge of how marine ecosystems work to how they are affected by human activity and address limits to capacity, interactions between multiple stressors, the dynamics of cumulative effects, and the underlying controlling factors of ecological recovery	Enhanced protection and restoration of marine biodiversity through the use of new techniques for measuring, understanding and monitoring marine systems. Information and support tools on habitats and ecosystem services underlie spatial management processes (e.g., in the Hauraki Gulf). The programme provides the fundamental basis of an ecosystem-based approach to management of resources within New Zealand's marine ecosystems. It helps resource managers to make decisions that balance resource use and the maintenance of biodiversity when there are multiple resource users with varying societal, economic and cultural values.	1, 5	1,740,000	1,586,700
Marine biosecurity: Identifying and evaluating biosecurity threats to marine ecosystems from non-indigenous species and developing tools and approaches to prevent entry, reduce establishment and mitigate impacts	A wide variety of novel tools and information enables robust estimates of aquatic biosecurity risks, effective pest surveillance and monitoring, and the development and implementation of effective, socially and environmentally acceptable mitigation options. The programme supports interventions at different points in the biosecurity system; from prevention (pre-border), through surveillance and incursion response (border measures), to management and mitigation of impacts (pest management).	5	1,180,000	1,167,400

Freshwater and Estuaries

MBIE priority area: Land and freshwater resources

SCI programme	Sector benefits	SCP outcome No.	Core Funding investment ($) Budget, 2014	Core Funding investment ($) Actual, 2014
Water resources: Understanding and predicting the hydrological cycle (how much water, where and when) to improve water management	Better decisions on major water resource developments through the uptake and use of decision-support and other tools by regional councils and industry. For example, the use by industry of forecasting tools to assist in managing irrigation schemes and in making informed decisions about water use and allocation.	1, 5	130,000	130,000
Sustainable water allocation: Understanding and predicting effects of human use and modification of rivers and groundwater systems for sustainable allocation	Provision of management tools that help identify effects of complex water use, set appropriate flow levels, and quantify trade-offs between water allocated to in-stream values and out-of-stream uses. Water-use allocation plans and decisions are made so that river environments and their ecosystems are sustained. Key tools and a variety of statistical models are being applied by end users for water management planning and decision making. The knowledge generated in the programme has been used to develop guidance for, and assist with, defining environmental limits for the National Objectives Framework, and to inform consenting decisions.	1, 5	2,170,000	2,061,500
Causes and effects of water quality degradation: Understanding and predicting the sources of contaminants, technologies to clean up the sources, and consequences of water quality degradation for aquatic ecosystems and human uses of waters	Support implementation of the National Policy Statement for Freshwater Management and National Objectives Framework by providing updated water-quality guidelines for nitrate in freshwaters to include multiple native species, and by developing methods for setting limits and assessing the performance of "water-sensitive urban design" in urban catchments.	1, 5	350,000	436,200
Catchments to estuaries: Understanding and predicting the functional connections between catchments and estuaries to improve diffuse-source contaminant management	Provision of direct support for the implementation of limits-based management of estuaries, and increased access to science-based tools for regional council managers, which this year included the use of advanced models of sediment footprints in estuaries. These will be used by stakeholders to develop and agree on catchment sediment load limits designed to achieve a range of environmental objectives in estuaries.	5	300,000	537,500
Freshwater biosecurity: Identifying and evaluating threats from non-indigenous species, minimising risks of their establishment, and developing tools to mitigate their impacts	Reduced threat and spread of invasive aquatic plant species in major catchments (e.g., Waitaki) and lakes (e.g., Wanaka, Wakatipu and Waikaremoana) by providing tools and strategies that control existing pest problems. Research findings, advice and input to strategic management has led to enhanced ecosystem health and helped meet community expectations in a range of nationally and regionally important waterbodies. Novel tools to control perch populations will help manage biosecurity threats to native biodiversity.	5	650,000	699,200
Ensuring ecosystem health: Developing techniques for biodiversity enhancement, rehabilitation and protection of freshwater values under future economic growth scenarios	Provision of techniques for protecting, enhancing and rehabilitating the biodiversity of freshwater ecosystems and the cultural value they provide. This small Core-Funded component supports contestable research on seagrass and mangroves, which enables management programmes for both species to be optimally designed and well implemented. For example, research on mangroves is contributing to the development of effective mangrove removal guidelines, and is providing options for councils and estuary care groups for best practice methods for mangrove removals.	5	130,000	219,400

Hazards

MBIE priority area: Hazards

SCI programme	Sector benefits	SCP outcome No.	Core Funding investment ($) Budget, 2014	Core Funding investment ($) Actual, 2014
Develop predictive models of weather-related hazards and incorporate them into an operational multi-hazard forecasting system	Increased resilience to extreme weather hazard events through a forecasting and information-delivery system that provides accurate, location-specific, warning of anticipated events, leading to improved adaptive risk mitigation decisions. End users have direct access to decision-enabling tools for use in a wide range of sectors (e.g., urban coastal planning, ship operations, horticulture, river floods, snow effects on infrastructure and fire in the rural landscape).	3	3,280,000	3,420,500
Evaluate the risk, impacts and potential losses due to weather-related hazards to inform planning for mitigation and emergency response	Supplies the quantitative natural-hazard impact and loss-modeling requirements of New Zealand and the Pacific Islands, to make informed decision making on managing or planning for the adverse effects of weather-related and marine geological natural hazards. Developed products (e.g., hazard exposure maps) have been included in local government plans and will contribute to engineering development standards. Tools relating to coastal inundation and sea-level rise have been used directly by a number of councils, and will guide building regulations, property status reports and design of coastal infrastructure.	3	1,180,000	1,180,000

Climate and Atmosphere

MBIE priority areas: Climate and atmosphere; Antarctica

SCI programme	Sector benefits	SCP outcome No.	Core Funding investment ($) Budget, 2014	Core Funding investment ($) Actual, 2014
Monitor atmospheric constituents relevant to climate change to report the state of the atmosphere and improve models that make long-term predictions of global change	An informed international science community and national stakeholders about the state of the atmosphere in the New Zealand region. The long-term high-quality measurements (in Wellington, Otago and Antarctica) are used by the international atmospheric research community to detect composition variability and change, and test climate models. These are the most comprehensive set of internationally recognised high-quality measurements in the Southern Hemisphere, and New Zealand has international leadership in some measurements. Emphasis this year was placed on renewing outdated electronic equipment to ensure the continuity of long-term measurements.	4, 6	1,770,000	2,288,500
Quantify New Zealand's greenhouse gas emissions to improve national inventories and validate mitigation options	Long-term, high-precision measurement of CO_2, and improved assessments of agricultural emission and mitigation efficacy, are used to help measure and verify the efficacy of mitigation strategies, and to inform guidelines for agricultural greenhouse gas emissions. The Lauder site is of key international importance, and provides data that enable the validation of satellite-based carbon measurements. The programme maintains high standards of quality data needed for comparability and evaluation, whilst developing and innovating to meet an increasing range of applications.	4	1,170,000	1,170,000
Determine the role of oceans in governing climatically important gases and thereby improve global models and inform geoengineering options	Data on the variability of CO_2 uptake by the oceans in the southwest Pacific region are used in regional carbon models and by the international carbon research community. National and international researchers and policymakers are informed on ocean acidification, particularly in the southwest Pacific region. New initiatives are established to support the *Deep South* National Science Challenge, as well as contributing to the development of international activities.	4, 6	950,000	950,200

Climate and Atmosphere *continued*

SCI programme	Sector benefits	SCP outcome No.	Core Funding investment ($) Budget, 2014	Core Funding investment ($) Actual, 2014
Observe and analyse the climate of the New Zealand region, including Antarctica, to determine how the dynamics of the climate system influences our region, and identify the causes of changes	Observations of the atmosphere and ocean are available and their use is critical in other climate programmes (e.g., climate modeling, impact studies). The programme supports the quality control and analysis of the data to develop an understanding of the climate system around New Zealand and to detect change. Key information is used by the government, community and researchers here and overseas to better manage lives and businesses. For example, monitoring of snow and ice enables the present and future impacts of climate on nationally critical water and water-related resources (used for power generation, agriculture and tourism) to be managed.	4, 6	1,800,000	1,800,000
Develop improved predictions of climate and climate extremes on all timescales through dynamical modeling and statistical techniques	Better predictions of climate and climate extremes, from weeks to a 50–100 year timescale, which improve, for example, management of climate-sensitive industries and central and local government risk assessment and planning. Operational seasonal climate outlooks are applied widely in hydrology and impact studies. Climate projections have led to increased local government and public awareness of the implications of changes in temperature and heavy rainfall, including the substantial increase in the frequency of flooding events.	3, 4	1,790,000	1,320,000
Determine present and future vulnerability, impacts and adaptation options to climate variability and changes in New Zealand, the southwest Pacific, Southern Oceans and Antarctica	Access to better, more easily understood, and more policy-relevant, information for climate-sensitive end users. This climate information is used by a wide range of New Zealand organisations, including local and regional councils, sectors such as dryland farming and health, winter season tourism, engineering consultancies, iwi/hapū, central government, research institutes, media and the general public to inform, manage and plan their activities, leading to reduced vulnerability of our communities to the risks of climate variability, extreme events and climate change. The programme continues to be an extremely significant and important research and outreach mechanism for climate-based end-user-focused information, products and services. There is increased uptake of future-focused, risk-based information by local and regional councils, the tourism and health sectors, and by Pacific Island nations.	4, 6	590,000	530,000
Determine the impacts of air pollutants on human health and evaluate mitigation options	Provision of tools and data that are focused on rapid assessment and policy effectiveness for the air quality standards deadlines in 2016 and 2020. Councils are able to gauge the effectiveness of policy interventions, and if necessary plan and implement processes and any additional actions required for meeting air quality standards. A range of new, refined tools for understanding and managing transport emissions and impacts is now used by key regional councils.	4	1,070,000	1,070,000

Te Kūwaha

MBIE priority area: Land and freshwater resources

SCI programme	Sector benefits	SCP outcome No.	Core Funding investment ($) Budget, 2014	Core Funding investment ($) Actual, 2014
Develop tools for the management and restoration of aquatic taonga species	Facilitates the effective participation of Māori in aquatic resource management, and benefits the health and wellbeing of taonga species and Māori communities. This includes implementation of taonga/customary species-management and restoration strategies (particularly eels, lamprey and koaro), use of frameworks and tools to monitor the success of restoration initiatives, and use of databases and decision-support tools for Māori.	1, 5	200,000	200,000
Develop knowledge and tools that support investment and returns from the Māori economy	Science expertise has been applied across the various sectors in Māori economic development. Resource inventories have been completed for iwi across the country to help Māori economic entities understand and effectively utilise their resources.	1, 5	200,000	200,000

Environmental Information

MBIE priority area: Science collections and infrastructure

SCI programme	Sector benefits	SCP outcome No.	Core Funding investment ($) Budget, 2014	Core Funding investment ($) Actual, 2014
Environmental monitoring: Develop innovative environmental monitoring technologies, demonstrate these through benchmark sites, and work with other agencies to ensure consistent and robust environmental monitoring across New Zealand.	Access to high-quality data that are used in New Zealand science programmes, placed in international data repositories and used by industry, consultancies, and all levels of government. Ongoing developments are providing greater accessibility of metadata, and continuing investment in modern telemetry methods is enabling more timely information to be collected and disseminated, improving, for example, environmental hazard forecasting.	1–5	4,810,000	4,640,000
Information management: Implement and maintain robust information infrastructures to provide futureproof archives for New Zealand's climate, freshwater, marine and biological information.	A robust information infrastructure enables NIWA's environmental data (e.g., freshwater hydrology, climate) to be managed throughout the entire data life cycle so it is discoverable, robust and reusable. It ensures the quality and integrity of New Zealand's environmental information for the benefit of all New Zealanders. Other forms of environmental data, such as marine biology, ocean geology, and oceanography, are in the process of being moved into innovative and integrated systems.	1–5	1,100,000	1,240,000
Information delivery: Develop state-of-the-art, user-centric delivery services that enable information access and re-use for improved resource management and business decisions.	Provision of information delivery mechanisms (e.g., a standardised set of web-service protocols for information transfer, improvements in web-delivery portals, a metadata catalogue, etc.) that result in improved discovery and delivery of available data for all stakeholders to use in internal decision making, planning and other processes such as for drought declarations.	1–5	300,000	300,000

Capability

MBIE priority area: Capability

SCI programme	Sector benefits	SCP outcome No.	Core Funding investment ($) Budget, 2014	Core Funding investment ($) Actual, 2014
National Centre operations and end-user engagement	NIWA's National Centres provide a communications, outreach and technology-transfer framework for NIWA research and services. Each National Centre acts as a focal point for effective engagement with key end users, and for the coordination of research in that area for the benefit of New Zealand.	1–5	1,340,000	1,638,100
Key activities to develop capability	Strengthened international collaboration, new skills and capabilities, transfer of expertise to NIWA and contribution to core research.	1, 3–6	2,010,000	1,495,600

FINANCIAL STATEMENTS

Doon rain gauge, Fiordland.

Evan Baddock

Statement of comprehensive income

For the year ended 30 June 2015

in thousands of New Zealand dollars	Notes	2015 Actual	2015 SCI Budget	2014 Actual
Revenues and other gains	4			
Revenue		126,190	126,604	123,397
Other gains		69	–	142
Total income		**126,259**	**126,604**	**123,539**
Operating expenses	5			
Employee benefits expense		(60,536)	(62,450)	(59,052)
Other expenses		(43,735)	(44,249)	(44,485)
		(104,271)	**(106,699)**	**(103,537)**
Profit before interest, income tax, depreciation, and amortisation		**21,988**	**19,905**	**20,002**
Depreciation and impairment	11	(13,684)	(13,195)	(12,504)
Amortisation	13	(694)	(298)	(381)
Profit before interest and income tax		**7,610**	**6,412**	**7,117**
Interest income		432	135	251
Finance expense		(37)	(7)	(44)
Net interest and other financing income/(expense)	6	**395**	**128**	**207**
Profit before income tax		**8,005**	**6,540**	**7,324**
Income tax expense	7	(2,250)	(1,834)	(2,046)
Profit for the period		**5,755**	**4,706**	**5,278**
Other comprehensive income				
Foreign currency translation differences for foreign operations		40	–	(107)
Total comprehensive income for the period		**5,795**	**4,706**	**5,171**
Profit attributable to:				
Owners of the Parent		5,745	4,708	5,285
Non-controlling interest		10	(2)	(7)
Profit for the period		**5,755**	**4,706**	**5,278**
Total comprehensive income attributable to:				
Owners of the Parent		5,785	4,708	5,178
Non-controlling interest		10	(2)	(7)
Total comprehensive income for the period		**5,795**	**4,706**	**5,171**

The accompanying 'Notes to the financial statements' are an integral part of, and should be read in conjunction with, these financial statements.

Statement of changes in equity

For the year ended 30 June 2015

in thousands of New Zealand dollars	Share capital	Retained earnings	Non-controlling interest	Foreign currency translation reserve	Total equity
Balance at 1 July 2013	**24,799**	**75,578**	**176**	**(117)**	**100,436**
Profit for the year	–	5,285	(7)	–	5,278
Translation of foreign operations	–	–	–	(107)	(107)
Total comprehensive income	–	5,285	(7)	(107)	5,171
Dividend to equity holders	–	(2,000)	–	–	(2,000)
Balance at 30 June 2014	**24,799**	**78,863**	**169**	**(224)**	**103,607**
Balance at 1 July 2014	**24,799**	**78,863**	**169**	**(224)**	**103,607**
Profit for the year	–	5,745	10	–	5,755
Translation of foreign operations	–	–	–	40	40
Total comprehensive income	–	5,745	10	40	5,795
Dividend to equity holders	–	(4,000)	–	–	(4,000)
Balance at 30 June 2015	**24,799**	**80,608**	**179**	**(184)**	**105,402**

The accompanying 'Notes to the financial statements' are an integral part of, and should be read in conjunction with, these financial statements.

Statement of financial position

As at 30 June 2015

in thousands of New Zealand dollars	Notes	2015 Actual	2015 SCI Budget	2014 Actual
EQUITY AND LIABILITIES				
Equity				
Share capital	8	24,799	24,799	24,799
Equity reserves		80,424	77,354	78,639
Shareholders' interest		**105,223**	**102,153**	**103,438**
Non-controlling interest		179	197	169
Total equity		**105,402**	**102,350**	**103,607**
Non-current liabilities				
Provision for employee entitlements	9	436	506	488
Deferred tax liability	10	7,653	7,791	7,618
Total non-current liabilities		**8,089**	**8,297**	**8,106**
Current liabilities				
Payables and accruals		9,305	10,303	12,713
Revenue in advance		4,507	7,431	3,474
Provision for employee entitlements	9	1,231	1,432	1,198
Accrued employee entitlements	9	6,001	6,528	7,483
Taxation payable		650	833	1,714
Forward exchange derivatives		–	–	27
Total current liabilities		**21,694**	**26,527**	**26,609**
Total equity and liabilities		**135,185**	**137,174**	**138,322**
ASSETS				
Non-current assets				
Property, plant, and equipment	11	100,872	104,719	100,127
Identifiable intangibles	13	1,649	1,000	1,188
Receivables	14	–	–	265
Prepayments		19	–	32
Total non-current assets		**102,540**	**105,719**	**101,612**
Current assets				
Cash and cash equivalents		9,863	3,945	12,992
Forward exchange derivatives		13	8	–
Receivables	14	13,964	17,599	15,271
Prepayments		1,942	2,727	1,962
Uninvoiced receivables		4,937	4,373	4,361
Inventory	15	1,926	2,803	2,124
Total current assets		**32,645**	**31,455**	**36,710**
Total assets		**135,185**	**137,174**	**138,322**

The accompanying 'Notes to the financial statements' are an integral part of, and should be read in conjunction with, these financial statements.

Cash flow statement

For the year ended 30 June 2015

in thousands of New Zealand dollars	Notes	2015 Actual	2015 SCI Budget	2014 Actual
Cash flows from operating activities				
Cash was provided from:				
Receipts from customers		128,510	126,771	126,050
Dividends received		2	–	1
Interest received		432	127	251
Cash was disbursed to:				
Payments to employees and suppliers		(108,890)	(107,388)	(103,986)
Interest paid		(37)	(7)	(44)
Taxation (paid)/refund		(3,281)	(1,844)	(502)
Net cash inflow from operating activities	16	16,736	17,659	21,770
Cash flows from investing activities				
Cash was provided from:				
Sale of property, plant, and equipment		69	–	166
Cash was applied to:				
Purchase of property, plant, and equipment	11	(14,525)	(12,541)	(9,681)
Purchase of intangible assets	13	(1,118)	–	(1,021)
Net cash (outflow) in investing activities		(15,574)	(12,541)	(10,536)
Cash flows from financing activities				
Cash was applied to:				
Minority shareholder loan (repaid)		–	–	(395)
Dividends paid		(4,000)	(4,000)	(2,000)
Net cash (outflow) /inflow from financing activities		(4,000)	(4,000)	(2,395)
Increase in cash and cash equivalents		(2,838)	1,118	8,839
Effects of exchange rate changes on the balance of cash held in foreign currency		(291)	–	(119)
Opening balance of cash and cash equivalents		12,992	2,827	4,272
Closing cash and cash equivalents balance		**9,863**	**3,945**	**12,992**
Made up of:				
Cash at bank		1,483	3,945	1,501
Short-term deposits		8,380	–	11,491
Closing cash and cash equivalents balance		**9,863**	**3,945**	**12,992**

The accompanying 'Notes to the financial statements' are an integral part of, and should be read in conjunction with, these financial statements.

For and on behalf of the Board:

Chris Mace
Chairman

Nicholas Main
Director

The financial statements were authorised for issue by the directors on 18 August 2015.

1. Reporting entity

National Institute of Water and Atmospheric Research Limited ('NIWA' or 'the Company') and its subsidiaries form the consolidated Group ('the NIWA Group' or 'the Group'). NIWA is a profit-oriented company registered in New Zealand under the Companies Act 1993.

The financial statements for the NIWA Group are presented in accordance with the requirements of the Crown Research Institutes Act 1992, the Crown Entities Act 2004, the Public Finance Act 1989, the Companies Act 1993, and the Financial Reporting Act 2013.

2. Nature of activities

The NIWA Group conducts research and applied science in water and atmospheric sciences in New Zealand and internationally.

3. Basis of preparation

The measurement basis adopted in the preparation of these financial statements is historical cost, except for financial instruments as identified in specific accounting policies below. Cost is based on the fair value of consideration given in exchange for assets.

The presentation currency of the Group and functional currency used in the preparation of these financial statements is New Zealand dollars.

Accounting policies are selected and applied in a manner that ensures that the resulting financial information meets the concepts of relevance and reliability, ensuring that the substance of the underlying transaction or event is reported.

The accounting policies have been applied in preparing the financial statements for the year ended 30 June 2015 and the comparative information for the year ended 30 June 2014.

Statement of compliance

The financial statements have been prepared in accordance with New Zealand generally accepted accounting practice (NZ GAAP). They comply with New Zealand equivalents to International Financial Reporting Standards (NZ IFRS) and other applicable financial reporting standards appropriate for profit-oriented entities.

The financial statements comply with International Financial Reporting Standards (IFRS).

Adoption of new and revised standards

Certain new standards, amendments and interpretations of existing standards have been published that are mandatory for later periods and which the Group has not adopted early. The key items applicable to the Group are:

NZ IFRS 15: Revenue from contracts with customers (effective for annual periods beginning on or after 1 January 2017)

NZ IFRS 15 deals with revenue recognition and establishes principles for reporting useful information to users of financial statements about the nature, amount, timing and uncertainty of revenue and cash flows arising from an entity's contracts with customers. Revenue is recognised when a customer obtains control of a good or service and thus has the ability to direct the use and obtain the benefits from the good or service. The standard replaces NZ IAS 18 'Revenue' and NZ IAS 11 'Construction contracts' and related interpretations. The standard is effective for annual periods beginning on or after 1 January 2017 and earlier application is permitted. The group intends to adopt NZ IFRS 15 on its effective date and has yet to assess its full impact.

NZ IFRS 9: Financial Instruments (effective for accounting periods beginning on or after 1 January 2018)

NZ IFRS 9 addresses the classification, measurement and recognition of financial assets and financial liabilities. The complete version of NZ IFRS 9 was issued in September 2014. It replaces the guidance in NZ IAS 39 that relates to the classification and measurement of financial instruments. NZ IFRS 9 retains but simplifies the mixed measurement model and establishes three primary measurement categories for financial assets: amortised cost, fair value through other comprehensive income and fair value through profit or loss. The basis of classification depends on the entity's business model and the contractual cash flow characteristics of the financial asset. Investments in equity instruments are required to be measured at fair value through profit or loss with the irrevocable option at inception to present changes in fair value in other comprehensive income not recycling. There is now a new expected credit losses model that replaces the incurred loss impairment model used in NZ IAS 39. For financial liabilities there were no changes to classification and measurement except for the recognition of changes in own credit risk in other comprehensive income, for liabilities designated at fair value through profit or loss. NZ IFRS 9 relaxes the requirements for hedge effectiveness by replacing the bright line hedge effectiveness tests. It requires an economic relationship between the hedged item and hedging instrument and for the 'hedged ratio' to be the same as the one management actually use for risk management purposes. Contemporaneous documentation is still required but is different to that currently prepared under NZ IAS 39. The standard is effective for accounting periods beginning on or after 1 January 2018. Early adoption is permitted.

The group intends to adopt NZ IFRS 9 on its effective date and has yet to assess its full impact.

There are no other NZ IFRS's or NZ IFRIC interpretations that are not yet effective that would be expected to have a material impact on the Group.

Foreign currencies

Transactions

Transactions in foreign currencies are converted to the functional currency of the Group, being New Zealand dollars, by applying the spot exchange rate between the functional currency and the foreign currency at the date of transaction. At the end of each reporting period, monetary assets and liabilities are translated to New Zealand dollars using the closing rate of exchange at balance date, and any exchange gains or losses are recognised in the statement of comprehensive income.

Translation of foreign operations

On consolidation, revenues and expenses of foreign operations are translated to New Zealand dollars at the average exchange rates for the period. Assets and liabilities are converted to New Zealand dollars at the rates of exchange ruling at balance date. Exchange rate differences arising from the translation of the foreign operations are recognised in other comprehensive income and accumulated as a separate component of equity in the Group's foreign currency translation reserve. Such exchange differences are reclassified from equity to profit or loss (as a reclassification adjustment) when the foreign operation is disposed of.

Goods and services tax (GST)

These financial statements are prepared on a GST-exclusive basis, except for receivables and payables, which are stated GST-inclusive.

Statement of cashflows

The statement of cash flows is prepared exclusive of GST, which is consistent with the method used in the statement of comprehensive income. Operating activities comprise the provision of research services, consultancy, and manufacture of scientific instruments and other activities that are not investing or financing activities. Investing activities comprise the purchase and disposal of property, plant, and equipment, intangible assets, and advances to subsidiaries. Financing activities are those which result in changes in the size and composition of the capital structure of the Group.

Cash and cash equivalents comprise cash on hand, cash in banks, and investments in the money market, net of outstanding bank overdrafts.

4. Revenues and other gains

Rendering of services

Revenue from services rendered is recognised in profit or loss in proportion to the stage of completion of the transaction at reporting date. The amount of revenue unbilled at balance date is recognised as 'uninvoiced receivables' in the statement of financial position, while revenue received but not earned is recognised as 'revenue in advance'.

Goods sold

Revenue from the sale of goods is measured at the fair value of the consideration received or receivable, net of returns and allowances. Revenue is recognised when the significant risks and rewards of ownership have been transferred to the buyer, recovery of the consideration is probable, the associated costs and possible return of goods can be estimated reliably, and there is no continuing management involvement with the goods.

Transfers of risks and rewards vary depending on the individual terms of the contract sale.

Dividend revenue

Dividend revenue from investments is recognised when the shareholders' right to receive payment has been established.

Core funding

NIWA and the Crown are parties to a Core Funding Agreement (CFA) under which the Crown contracts NIWA to perform research activities that support NIWA's Statement of Core Purpose (SCP). Specific SCP outcomes, and their associated delivery programmes, are agreed annually with Shareholding Ministers and documented in NIWA's Statement of Corporate Intent.

For financial reporting purposes this Core Funding is treated as a Government Grant in terms of NZ IAS 20. Core Funding is recognised as income in profit or loss on a systematic basis in the period in which the expenses related to the research activities performed under the CFA are recognised. Core funding received during the year was $42.841 million exclusive of GST (2014: $42.854 million). All core funded projects were completed during the year.

Uninvoiced receivables

The amount of revenue unbilled at balance date is represented by 'uninvoiced receivables', which are stated in proportion to the stage of completion of the transaction in the statement of financial position. Once this balance is invoiced it is transferred to trade debtors.

Management believe there are no significant concentrations of risk relating to this balance.

Judgement in applying accounting policies

In determining the revenue to be recognised in the year from the rendering of services the directors have exercised their judgement in respect of the percentage of completion of contracts as outlined in the above policy.

In making their judgement, the directors considered:

- whether total contract revenue could be measured reliably;
- the probability that economic benefits associated with the contract will flow to the Group;
- whether the contract costs to complete the contract and the stage of contract completion at balance date could be reliably measured; and
- whether the contract costs attributable to the contract can be clearly identified and measured reliably so that the actual contract costs incurred can be compared with prior estimates.

Following review of the Group's contract transactions the directors are satisfied that the above criteria have been met and the recognition of the revenue in the current year is appropriate, in conjunction with the recognition of appropriate uninvoiced receivables and revenue in advance balances.

Revenue and other gains

in thousands of New Zealand dollars	2015	2014
Research		
Rendering of services	64,075	65,176
Applied Science		
Rendering of services	59,042	53,633
Sale of goods	3,071	4,587
Dividends	2	1
Gain on sale from property, plant, and equipment	69	142
Total revenue and other gains	**126,259**	**123,539**

5. Other operating expenses and other gains

Employee benefits

in thousands of New Zealand dollars	2015	2014
Defined contribution plans	2,753	2,619
Termination benefits	31	134
Other employee benefits	57,752	56,299
Employee benefit expense	**60,536**	**59,052**

Other Expenses and other gains and (losses)

in thousands of New Zealand dollars	2015	2014
Materials and supplies	11,682	12,747
Research collaboration	11,958	11,276
Property occupancy costs	5,758	5,974
Information technology	4,717	4,044
Remuneration of directors	297	297
Foreign currency gain (loss)	144	3
Movement within doubtful debt provision	28	(30)
Bad debts written off	1	1
Change in the fair value of derivatives	(13)	27
Other expenses	8,976	9,975
	43,548	**44,314**

Auditors remuneration

in thousands of New Zealand dollars	2015	2014
Auditor's remuneration comprises:		
Audit of the financial statements	183	171
Other assurance services (ACC audit)	4	–
Total auditor's remuneration	**187**	**171**

6. Net interest and other financing income

Interest income and expense is accrued on a time basis using the effective interest method.

7. Income tax

The income tax expense for the period is the tax payable on the current period's taxable income, based on the income tax rate for each jurisdiction. This is then adjusted by changes in deferred tax assets and liabilities attributable to temporary differences between the tax bases of assets and liabilities and their carrying amounts in the financial statements, and changes in unused tax losses.

The income tax expense is determined as follows:

in thousands of New Zealand dollars	2015	2014
Income tax expense		
Current tax	2,215	2,241
Deferred tax relating to temporary differences	35	(195)
Income tax expense	**2,250**	**2,046**

Reconciliation of income tax expense

in thousands of New Zealand dollars	2015	2014
Operating profit before income tax	**8,005**	**7,324**
Tax at current rate of 28%	2,241	2,051
Adjustments to taxation:		
Other non-deductible expenses	28	35
R&D tax concession	(28)	(27)
Under/(over) provision in previous year	9	(13)
Income taxation expense	**2,250**	**2,046**

8. Share capital

in thousands of New Zealand dollars	2015	2014
Issued and fully paid capital 24,798,700 ordinary shares (2014: 24,798,700 ordinary shares)	24,799	24,799

All shares carry equal voting and distribution rights.

9. Employee entitlements

Liabilities for wages and salaries, including non-monetary benefits and annual leave, long service leave, retirement leave, and training leave are recognised when it is probable that settlement will be required and they are capable of being measured reliably. Provisions, in respect of employee benefits, are measured at their nominal values using the remuneration rate expected to apply at settlement. Employee benefits are separated into current and non-current liabilities. Current liabilities are those benefits that are expected to be settled within 12 months of balance date.

Provisions made in respect of employee benefits which are not expected to be settled within 12 months are measured at the present value of the estimated future cash outflows to be made by the Group in respect of services provided by employees up to the reporting date.

in thousands of New Zealand dollars	2015	2014
Remuneration		
Salary accrual	1,002	2,430
Annual leave	4,999	5,053
Training leave	222	188
Long service leave	1,009	1,010
Retirement leave	436	488
Total employee entitlements	**7,668**	**9,169**
Comprising:		
Current	7,232	8,681
Non-current	436	488

The provisions for long service leave, retirement leave, and training leave are dependent upon a number of factors that are determined by the expected employment period of employees, current remuneration, and the timing of employees use of the benefits. Any changes in these assumptions will impact on the carrying amount of the liability. The employment period used to determine the appropriate long service leave liability is based upon historical average length of service. The training leave liability is based upon typical historical usage of the benefit.

10. Deferred tax liability and assets

Deferred tax is accounted for using the balance sheet liability method in respect of temporary differences arising from the carrying amount of assets and liabilities in the financial statements and the corresponding tax base of those items. Deferred tax liabilities are generally recognised for all taxable temporary differences. Deferred tax assets are generally recognised for all deductible temporary differences to the extent that it is probable that sufficient taxable amount will be available against which those deductible temporary differences can be utilised.

Deferred tax liabilities are recognised for the taxable temporary differences arising on investment in subsidiaries, associates and joint ventures, except where the consolidated entity is able to control the reversal of the temporary differences and it is probable that the temporary difference will not reverse in the foreseeable future. Deferred tax assets arising from deductible temporary difference from these investments are only recognised to the extent that it is probable there will be sufficient taxable profits against which to utilise the asset, and they are expected to reverse in the foreseeable future.

Such assets and liabilities are not recognised if the temporary difference arises from the initial recognition (other than in a business combination) of other assets and liabilities in a transaction that affects neither the taxable profit nor the accounting profit.

Deferred tax assets and liabilities are measured at the tax rates that are expected to apply to the period when the asset and liability giving rise to them are realised or settled, based on the tax laws that have been enacted or substantively enacted at balance date.

Current and deferred tax is recognised in profit or loss, except when it relates to items recognised in other comprehensive income or directly in equity, in which case the deferred or current tax is also recognised in other comprehensive income or directly in equity, or where it arises from the initial accounting for a business combination. In the case

of a business combination, the tax effect is taken into account in calculating goodwill or in determining the excess of the acquirer's interest in the net fair value of the acquiree's identifiable assets, liabilities, and contingent liabilities over the cost of the business combination. The carrying amount of deferred tax assets is reviewed at each balance date and reduced to the extent that it is no longer probable that sufficient taxable profits will be available be recovered.

in thousands of New Zealand dollars **As at 30 June 2015**	**Opening balance**	**Credited/ (charged) to profit or loss**	**Closing balance**
Temporary differences			
Property, plant, and equipment	(8,237)	136	(8,101)
Library	8	–	8
Uninvoiced receivables	(1,221)	(156)	(1,377)
Employee benefits	1,821	(41)	1,780
Doubtful debts	11	(11)	–
R&D Tax credit	–	37	37
	(7,618)	**(35)**	**(7,653)**

in thousands of New Zealand dollars **As at 30 June 2014**	**Opening balance**	**Credited/ (charged) to profit or loss**	**Closing balance**
Temporary differences			
Property, plant, and equipment	(8,130)	(107)	(8,237)
Library	10	(2)	8
Uninvoiced receivables	(1,418)	197	(1,221)
Employee benefits	1,725	96	1,821
Doubtful debts	–	11	11
	(7,813)	**195**	**(7,618)**

In accordance with the Income Tax Act 2007 the Group is not required to establish or maintain an imputation credit account by virtue of its classification as a Crown Research Institute.

11. Property, plant and equipment

Property, plant and equipment is stated at cost less accumulated depreciation to date, less any impairment losses.

Expenditure incurred on property, plant, and equipment is capitalised where such expenditure will increase or enhance the future economic benefits provided by an asset's existing service potential. Expenditure incurred to maintain future economic benefits is classified as repairs and maintenance.

The gain or loss arising on the disposal or retirement of an item of property, plant, and equipment is determined as the difference between the sale proceeds and the carrying amount of the asset and is recognised in profit or loss.

Property, plant, and equipment items, except for freehold land and work in progress, are depreciated on a straight line basis at rates estimated to write off their cost over their estimated useful lives, which are as follows:

Buildings and leasehold improvements	
Buildings	40 years
Leasehold improvements, freehold property	10 years
Leasehold improvements, rented property	5–12 years
Vessels	
RV *Tangaroa* hull	31 years
RV *Kaharoa* hull	25 years (2014: 16 years)
RV *Ikatere* hull	20 years
Plant and equipment	
Plant and equipment	10 years
Scientific equipment	8 years
EM300 swath system	4 years
Electronic data processing equipment	
Supercomputer	8 years
Electronic data processing equipment	3 years
Other	
Office equipment	5 years
Furniture and fittings	10 years
Small boats	10 years
Motor vehicles	6 years

Assumptions underlying the estimated useful life of assets include timing of technological obsolescence and future utilisation plans.

The useful life of the RV *Kaharoa* hull and engines was increased during the year from 16 to 25 years. While there was no resulting accounting adjustment, as the assets are fully depreciated, the change will be relevant in the event that any equipment is purchased in future for permanent integration into the vessel.

Major source of uncertainty

The useful lives of items of property, plant, and equipment are key assumptions concerning the future that have a significant risk of resulting in a material adjustment to the carrying amounts of assets and liabilities within the next financial year.

The Group reviews the estimated useful lives of property, plant, and equipment items during each annual reporting period.

in thousands of New Zealand dollars	Land	Buildings & leasehold improvements	Vessels	Plant & equipment	Electronic data processing equipment	Office equipment	Furniture & fittings	Motor vehicles	Small boats	Work in progress	Total
Cost											
Balance at 1 July 2014	12,450	50,473	40,183	94,401	26,618	8,829	2,251	4,100	3,073	2,779	245,157
Additions	3,185	1,075	–	6,853	1,648	448	32	303	78	911	14,533
Transfers	–	–	1,113	1,666	–	–	–	–	–	(2,779)	–
Disposals	–	(36)	(1,293)	(5,493)	(1,665)	(777)	(14)	(377)	(74)	–	(9,729)
Foreign currency	–	–	–	–	–	3	3	–	–	–	6
Balance at 30 June 2015	15.635	51,512	40,003	97,427	26,601	8,503	2,272	4,026	3,077	911	249,967
Accumulated depreciation and impairment losses											
Balance at 1 July 2014	–	24,114	17,193	68,674	20,092	7,954	2,085	3,076	1,842	–	145,030
Depreciation charge	–	2,322	2,216	5,408	2,778	339	37	330	134	–	13,564
Impairment	–	120	–	–	–	–	–	–	–	–	120
Disposals	–	(34)	(1,284)	(5,447)	(1,657)	(777)	(14)	(360)	(73)	–	(9,646)
Foreign currency	–	–	–	–	1	20	5	1	–	–	27
Balance as at 30 June 2015	–	26,522	18,125	68,635	21,214	7,536	2,113	3,047	1,903	–	149,095
Net book value at 30 June 2015	**15,635**	**24,990**	**21,878**	**28,792**	**5,387**	**967**	**159**	**979**	**1,174**	**911**	**100,872**

in thousands of New Zealand dollars	Land	Buildings & leasehold improvements	Vessels	Plant & equipment	Electronic data processing equipment	Office equipment	Furniture & fittings	Motor vehicles	Small boats	Work in progress	Total
Cost											
Balance at 1 July 2013	12,450	50,611	40,183	89,743	25,708	8,656	2,231	4,002	3,066	1,031	237,681
Additions	–	491	–	4,895	1,892	210	27	447	121	1,748	9,831
Disposals	–	(629)	–	(229)	(972)	(34)	–	(346)	(114)	–	(2,324)
Foreign currency	–	–	–	(8)	(10)	(3)	(7)	(3)	–	–	(31)
Balance at 30 June 2014	12,450	50,473	40,183	94,401	26,618	8,829	2,251	4,100	3,073	2,779	245,157
Accumulated depreciation and impairment losses											
Balance at 1 July 2013	–	22,338	15,163	64,262	18,372	7,597	2,053	3,120	1,834	–	134,739
Depreciation charge	–	2,281	2,030	4,637	2,711	387	37	300	121	–	12,504
Disposals	–	(505)	–	(216)	(970)	(30)	–	(344)	(113)	–	(2,178)
Foreign currency	–	–	–	(9)	(21)	–	(5)	–	–	–	(35)
Balance as at 30 June 2014	–	24,114	17,193	68,674	20,092	7,954	2,085	3,076	1,842	–	145,030
Net book value at 30 June 2014	**12,450**	**26,359**	**22,990**	**25,727**	**6,526**	**875**	**166**	**1,024**	**1,231**	**2,779**	**100,127**

12. Heritage assets

NIWA has one collection and three databases that have been defined as heritage assets. Heritage collection assets are those assets held for the duration of their physical lives because of their unique scientific importance, and heritage databases are maintained as an incidental part of existing business operations.

NIWA has the following heritage assets:

Type	Description
Marine Benthic Biology Collection	A national reference collection of marine invertebrates.
National Climate Database	A national electronic database of high-quality climate information, including temperatures, rainfall, wind, and other climate elements.
Water Resources Archive Database	A national electronic database of river and lake locations throughout New Zealand, including levels, quality, and flows.
New Zealand Freshwater Fish Database	A national electronic database of the occurrence of fish in the fresh waters of New Zealand, including major offshore islands.

The nature of these heritage assets, and their significance to the science NIWA undertakes, makes it necessary to disclose them. In the directors' view the cost of these heritage assets cannot be assessed with any reliability, and accordingly these assets have not been recognised for reporting purposes.

13. Intangible assets

Purchased identifiable intangible assets, comprising copyrights and software, are recorded at cost less amortisation and impairment. Amortisation is charged on a straight-line basis over the assets' estimated useful lives. The estimated useful life and amortisation method are reviewed each balance date.

The estimated useful life for copyrights is 5 years.

The estimated useful life for development costs is 5 years.

The estimated useful life for software is 3 years.

Intangible assets which arise from development costs that meet the following criteria are recognised as an asset in the statement of financial position:

- the product or process is clearly defined and the costs attributable to the product or process can be identified separately and measured reliably;
- the Group has the ability to use or sell the product or process;
- the Group intends to produce and market, or use, the product or process;
- the existence of a market for the product or process or its usefulness to the Group, if it is to be used internally, can be demonstrated; and
- adequate resources exist, or their availability can be demonstrated, to complete the projects and market or use the product or process.

Capitalisation is limited to the amount which, taken together with any further related costs, is likely to be recovered from related future economic benefits. Any excess is recognised as an expense.

All other development and research costs are expensed as incurred.

Subsequent to initial recognition, internally generated intangible assets are reported at cost, less accumulated amortisation and accumulated impairment losses, on the same basis as purchased identifiable intangible assets.

in thousands of New Zealand dollars	Software	Copyrights	Develop-ment costs	Total
Cost				
Balance as at 1 July 2014	7,905	215	–	8,120
Additions	1,119	–	35	1,154
Disposals	(4)	–	–	(4)
Balance as at 30 June 2015	9,020	215	35	9,270
Accumulated amortisation and impairment losses				
Balance as at 1 July 2014	6,717	215	–	6,932
Amortisation	694	–	–	694
Disposals	(5)	–	–	(5)
Balance as at 30 June 2015	7,406	215	–	7,621
Net book value at 30 June 2015	**1,614**	**–**	**35**	**1,649**

in thousands of New Zealand dollars	Software	Copyrights	Total
Cost			
Balance as at 1 July 2013	6,896	215	7,111
Additions	1,021	–	1,021
Disposals	(12)	–	(12)
Balance as at 30 June 2014	7,905	215	8,120
Accumulated amortisation and impairment losses			
Balance as at 1 July 2013	6,348	215	6,563
Amortisation	381	–	381
Disposals	(12)	–	(12)
Balance as at 30 June 2014	6,717	215	6,932
Net book value at 30 June 2014	**1,188**	**–**	**1,188**

14. Receivables

Receivables are stated at amortised cost using the effective interest rate, less any impairment.

Collectability of receivables is reviewed on an ongoing basis. A provision for doubtful debts 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. Changes in the carrying amount of the provision are recognised in profit or loss. Debts which are known to be uncollectable are written off against the provision, once approved by the Board of Directors.

in thousands of New Zealand dollars	2015	2014
Trade receivables	13,925	15,566
Sundry receivables	41	–
Provision for doubtful debts	(2)	(30)
Total	**13,964**	**15,536**
Classified as:		
Non-current	–	265
Current	13,964	15,271
	13,964	**15,536**

Included in the Group's trade receivables balance at the end of the year is one Crown debtor's balance which equates to 34 per cent for the Group's total trade receivables balance (2014: 40 per cent). 94 per cent of the debtor's balance is less than 60 days over-due and is deemed to be low credit risk.

The Group considers that a large proportion of its customers have a low credit risk associated with them. Before providing any service or goods to a new customer on credit terms, a check is undertaken when deemed appropriate to verify the credit-worthiness of the customer.

The Group reserves the right to charge interest at a rate of 2 per cent per month, calculated daily, on all invoices remaining unpaid at the due date.

Past due but not impaired trade receivables

in thousands of New Zealand dollars	2015	2014
Between 60 and 90 days	48	85
Between 91 and 180 days	52	105
Over 181 days	358	11
	458	**201**

Included in the Group's trade receivable balance are debtors with a carrying amount of $458k (2014: $201k) which are past due at the reporting date for which the Group has not provided as the amounts are still considered recoverable. The Group does not hold any collateral over past due or impaired balances.

The increase of $257k included in the above table is explained by a change in the classification of the receivables of one Crown debtor. In prior years, receivable balances with this debtor were treated as contract retentions rather than aged debts, however this is no longer the case.

Provision for doubtful debts

in thousands of New Zealand dollars	2015	2014
Balance at the beginning of the year	30	1
Impairment loss recognised	1	30
Impairment losses reversed	–	–
Amounts written off as uncollectible	(1)	(1)
Amounts recovered during the year	(28)	–
	2	**30**

Included in the provision for doubtful debts are individually identified debts totalling $2k (2014: $30k) for the Group which are unlikely to be recoverable. The provision recognises the difference between the carrying amount of these trade receivables and the expected recoverable amount. The net carrying amount is considered to approximate their fair value.

15. Inventory

Inventory is stated at the lower of cost and net realisable value. The basis on which cost is calculated is first in first out (FIFO) for consumables, finished goods and work in progress; and weighted average for raw materials.

in thousands of New Zealand dollars	2015	2014
Consumables	356	297
Raw materials	364	411
Finished goods	1,206	1,416
Total	**1,926**	**2,124**

16. Reconciliation of the profit for the period to net cash from operating activities

in thousands of New Zealand dollars	2015	2014
Profit for the period	**5,755**	**5,278**
Add/(less) items classified as investing activities		
Net loss/(gain) on disposal of property, plant and equipment	(2)	(26)
	(2)	**(26)**
Add/(less) non-cash items		
Depreciation and impairment	13,684	12,504
Amortisation of identifiable intangibles	694	381
Net foreign currency (gain)/loss	331	11
Increase/(decrease) in deferred tax liability	35	(195)
	14,744	**12,701**
Add/(less) movements in working capital items		
Increase/(decrease) in payables and accruals and revenue in advance	(2,385)	(1,657)
Increase/(decrease) in employee entitlements	(1,499)	(174)
(Increase)/decrease in receivables and prepayments	1,605	2,876
(Increase)/decrease in inventory and uninvoiced receivables	(377)	1,005
(Increase)/decrease in taxation receivable	(1,065)	1,740
Increase/(decrease) in forward exchange derivatives	(40)	27
	(3,761)	**3,817**
Net cash flows from operating activities	**16,736**	**21,770**

17. Dividends

in thousands of New Zealand dollars	2015	2014
Dividend payment	4,000	2,000
Dividends declared subsequent to balance date not provided for (see note 23)	-	4,000
Dividends per share paid in the year	$0.16	$0.08

The dividend payment was made to the Government of New Zealand (the Crown) as the sole shareholder.

18. Subsidiaries

The Group financial statements incorporate the financial statements of the Company and entities (including special purpose entities) controlled by the Company. Control is achieved where the Company has the power (including the ability to use the power) to govern the financial and operating policies of an entity so as to obtain benefits from its activities.

Non-controlling interests in the net assets of the consolidated subsidiaries may be initially measured either at fair value or at the non-controlling interest's proportionate share of the fair value of the acquirer's identifiable net assets. The choice of measurement basis is made on an acquisition-by-acquisition basis. Subsequent to acquisition, non-controlling interests consist of the amount attributed to such interests at initial recognition and the non-controlling interest's share of changes in equity since the date of the combination. Total comprehensive income is attributed to non-controlling interests even if this results in the non-controlling interests having a deficit balance.

The results of subsidiaries acquired or disposed of during the year are included in profit or loss from the effective date of acquisition or up to the effective date of disposal, as appropriate. Where necessary, adjustments are made to the financial statements of subsidiaries to bring the accounting policies used into line with those used by other members of the Group.

All intra-group transactions, balances, income, and expenses are eliminated in full on consolidation.

Changes in the Group's interests in a subsidiary that do not result in a loss of control are accounted for as equity transactions. Any difference between the amount by which the non-controlling interests are adjusted and the fair value of the consideration paid or received is recognised directly in equity and attributed to owners of the Company.

When the Group no longer has control of a subsidiary, the profit or loss on disposal is calculated as the difference between:

1. the aggregate of the fair value of the consideration received and the fair value of any retained interest; and
2. the previous carrying amount of the assets (including goodwill), and liabilities of the subsidiary and any non-controlling interests.

Amounts previously recognised in other comprehensive income in relation to the subsidiary are accounted for (i.e., reclassified to profit or loss or transferred directly to retained earnings) in the same manner as would be required if the relevant assets or liabilities were disposed of. The fair value of any investment retained in the former subsidiary at the date when control is lost is regarded as the fair value on initial recognition for subsequent accounting under NZ IAS 39 Financial Instruments: Recognition and Measurement, or, when applicable, the cost on initial recognition of an investment in an associate or jointly controlled entity.

The subsidiaries of the Group and their activities are listed below:

Name	Country	Principal activities	Ownership
NIWA Vessel Management Ltd	New Zealand	Vessel charters for scientific research	100%
Unidata Pty Ltd	Australia	Supplier of environmental technology products	80%
EcoConnect Ltd	New Zealand	Non-trading company	100%
NIWA Australia Pty Ltd	Australia	Non-trading company	100%
NIWA Environmental Research Institute	USA	Non-trading company	100%
NIWA Natural Solutions Ltd	New Zealand	Non-trading company	100%

All subsidiaries have a balance date of 30 June.

No stake in any subsidiary was acquired or disposed of during the year.

19. Related party transactions

The Government of New Zealand (the Crown) is the ultimate shareholder of the NIWA Group. No transactions with other New Zealand Government-owned entities are considered as related party transactions in terms of NZ IAS 24. No related party debts have been written off or forgiven during the year. Any business the NIWA Group has transacted in which a director or an employee has an interest has been carried out on a commercial 'arms-length' basis. Any potential conflict is recorded and minuted in Board meetings for directors and a separate interest register for employees. The interest register containing all relevant interests is updated on a regular and timely basis.

Key management personnel compensation

in thousands of New Zealand dollars	2015	2014
Short-term benefits	5,984	5,860

The table above includes remuneration of the Chief Executive and all key management positions.

20. Financial Instruments and Risk Management

Derivative financial instruments

The Group may use derivative financial instruments to hedge its exposure to foreign exchange and interest rate risks arising from operational, financing, and investing activities.

Derivative financial instruments such as forward exchange contracts are categorised as held for trading (unless they qualify for hedge accounting), and are initially recognised in the statement of financial position at fair value, and transaction costs are expensed immediately. Subsequent to initial recognition, derivative financial instruments are stated at fair value. The gain or loss on re-measurement to fair value is recognised immediately in profit or loss unless the derivative is designated and effective as a hedging instrument, in which event the timing of the recognition in profit or loss depends on the nature of the hedge relationship

Other financial assets

Non-derivative financial assets comprise receivables, cash and cash equivalents, uninvoiced receivables, and intercompany, and are initially recorded at fair value plus transaction costs (except for financial assets at fair value through profit or loss, which are initially recorded at fair value).

Financial assets are classified into the following specified categories; classification depends on the nature and purpose of the financial asset and is determined at the time of initial recognition.

Financial assets at fair value through profit or loss:

Financial assets are classified at fair value through profit or loss where the financial asset is either held for trading or it is designated at fair value through profit or loss.

A financial asset is classified as held for trading if:

- it has been incurred principally for the purpose of selling in the near future; or
- it is a derivative that is not designated and effective as a hedge instrument; or
- it is part of an identified portfolio of financial instruments that the Group manages together and has a recent actual pattern of short-term profit-making.

A financial asset other than a financial asset held for trading may be designated as at fair value upon recognition if:

- such designation eliminates or significantly reduces a measurement or recognition inconsistency that would otherwise arise; or
- the financial asset forms part of a group of financial assets or financial liabilities or both, which is managed and its performance is evaluated on a fair value basis, in accordance with either the Group's documented risk management or investment strategy, and information about the grouping is provided internally on that basis; or
- it forms part of a contract containing one or more embedded derivatives, and it is allowable to be designated at fair value through profit or loss.

Financial assets at fair value through profit or loss are classified as current assets and are stated at fair value, and changes resulting in a gain or loss are recognised in profit or loss.

Loans and receivables

Loans and receivables have fixed or determinable payments and are not quoted in an active market. They arise when the Group provides money, goods, or services directly to a debtor with no intention of selling the receivable. They are included in current assets, except for those with maturities greater than 12 months after the statement of financial position date which are classified as a non-current asset. These are subsequently recorded at amortised cost less impairment.

Impairment of financial assets

Financial assets, other than those at fair value through profit or loss, are assessed for indicators of impairment at each balance date. Financial assets are impaired where there is objective evidence that, as a result of one or more events that occurred after the initial recognition of the financial asset, the estimated future cash flows of the investment have been impacted.

For certain categories of financial assets, such as trade receivables, assets that are assessed not to be impaired individually are subsequently assessed for impairment on a collective basis. Objective evidence of impairment for a portfolio of receivables could include the Group's past experience of collecting payments, an increase in the number of delayed payments in the portfolio past the average credit period, as well as observable changes in national or local economic conditions that correlate with default on receivables.

For financial assets carried at amortised cost, the amount of the impairment is the difference between the asset's carrying amount and the present value of estimated future cashflows, discounted at the financial asset's original effective interest rate.

The carrying amount of the financial asset is reduced by the impairment loss with the exception of trade receivables, where the carrying amount is reduced through the use of an allowance account. When a trade receivable is considered uncollectible, it is written off against the allowance account. Changes in the carrying amount of the allowance account are recognised in profit or loss.

Financial liabilities

Financial liabilities are classified as either financial liabilities at fair value through profit or loss or other financial liabilities. Financial liabilities are classified as at fair value through profit or loss where the liability is either held for trading or it is designated as at fair value. A financial liability is classified as held for trading if it meets similar criteria as financial assets held for trading.

A financial liability other than a financial liability held for trading may be designated as at fair value through profit or loss upon recognition if it meets similar criteria as financial assets designated as at fair value through profit or loss.

Financial liabilities at fair value are stated at fair value with any resultant gain or loss recognised in profit or loss. This incorporates any interest paid on the financial liability.

Other financial liabilities are initially measured at fair value through profit or loss, net of transaction costs. Other financial liabilities are subsequently measured at amortised cost using the effective interest method, with interest expense recognised on an effective interest basis.

The effective interest method is the method of calculating the amortised cost of a financial liability and of allocating interest expense over the relevant period. The effective interest rate is the rate that discounts estimated future cash payments through the expected life of the financial liability, or, where appropriate, a shorter period to the net carrying amount of the financial liability.

The Group derecognises financial liabilities when, and only when, the Group's obligations are discharged, cancelled, or they expire.

Capital management

The Group has externally imposed requirements under the Crown Research Institutes Act 1992:

- to operate in a financially responsible manner so that sufficient operating funds are generated to maintain financial viability;
- to provide an adequate rate of return on shareholders' funds; and
- to operate as a going concern.

The Group's policy is to maintain a strong capital base so as to maintain investor and creditor confidence and to sustain future development of the business.

The Group's policies in respect of capital management and allocation are reviewed regularly by the Board of Directors.

The advance facility available from ANZ Bank (refer note 20 subsection financing facilities) is subject to two covenants:

1. That Shareholders' funds are maintained at not less than $50 million of net tangible assets; and
2. That ANZ reserves the right to review the facility in the event of a change in the shareholding structure.

Capital refers to the equity and borrowings of the Group.

There have been no material changes in the Group's management of capital during the period.

Fair value of financial instruments

The fair values of financial assets and financial liabilities are determined as follows:

Level 1 The fair value of financial assets and financial liabilities with standard terms and conditions and traded on active liquid markets is determined with reference to quoted market prices;

Level 2 The fair value of other financial assets and financial liabilities (excluding derivative instruments) is determined in accordance with valuation techniques based on discounted cash flow analysis using prices from observable recent market transactions, or dealer quotes for similar instruments; and

Level 3 The fair value of derivative instruments is calculated using quoted prices. Where such prices are not available, use is made of discounted cash flow analysis using the applicable yield curve for the duration of the instruments for non-optional derivatives, and option pricing models for optional derivatives.

The Group has no level 2 or 3 financial instruments. The carrying value of all financial instruments is considered to approximate fair value.

Categories of financial instruments

in thousands of New Zealand dollars **Balance at 30 June 2015**	**Note**	**Loans and receivables**	**Financial liabilities at amortised cost**	**Total**
Assets				
Cash and cash equivalents		9,863	–	
Receivables	14	13,964	–	
Uninvoiced receivables		4,937	–	
Total financial assets		28,764	–	28,764
Total non-financial assets				106,421
Total assets				**135,185**
Liabilities				
Payables and accruals		–	13,812	
Employee entitlements	9	–	7,668	
Total financial liabilities		–	21,480	21,480
Total non-financial liabilities				8,303
Total liabilities				**29,783**

in thousands of New Zealand dollars **Balance at 30 June 2014**	**Note**	**Loans and receivables**	**Financial liabilities at amortised cost**	**Total**
Assets				
Cash and cash equivalents		12,992	–	
Receivables	14	15,536	–	
Uninvoiced receivables		4,361	–	
Total financial assets		32,889	–	32,889
Total non-financial assets				105,433
Total assets				**138,322**
Liabilities				
Payables and accruals		–	16,187	
Employee entitlements	9	–	9,169	
Total financial liabilities		–	25,356	25,356
Total non-financial liabilities				9,359
Total liabilities				**34,715**

Credit risk

Credit risk is the risk that a third party will default on its obligations to NIWA and the Group, causing a loss.

In the normal course of business, the Group incurs credit risk from trade receivables, uninvoiced receivables, and transactions with financial institutions (cash and short-term deposits and derivatives).

The Group has a credit policy that is used to manage this risk. As part of this policy, limits are placed on the amounts of credit extended to third parties, and care is taken to ensure the credit-worthiness of third parties dealt with. All credit risk exposures are monitored regularly.

The Group does not require any collateral or security to support financial instruments, because of the quality of financial institutions and counterparties it deals with. There are no significant concentrations of credit risk.

The exposure to the Group to credit risk as at 30 June 2015 was $28,764k (total exposure to credit risk, comprising cash and cash equivalents $9,863k, uninvoiced receivables $4,937k, and receivables net of provisions $13,964k) (2014: $32,889k).

Further analysis on the trade receivables balance can be found in note 14.

The Group has not renegotiated the terms of any financial assets which would result in the carrying amount no longer being past due or avoid a possible past due status.

The Group's maximum exposure to credit risk by geographic region is as follows:

in thousands of New Zealand dollars	2015	2014
New Zealand	26,682	30,889
Australia	1,284	1,589
USA	386	119
Other Asia Pacific countries	209	291
Other regions	205	31
Provision for doubtful debts	(2)	(30)
Total credit risk	**28,764**	**32,889**

Interest rate risk

Interest rate risk is the risk that cashflows will fluctuate because of changes in market interest rates. This could particularly affect the return on investments.

The interest rates on the Group investments as at 30 June:

	2015	2014
Cash (on call)	3.25% - 3.5%	3.25% - 4.25%

The directors do not consider there is any significant exposure to interest rate risk.

NIWA has a regularly reviewed treasury policy in place which ensures the appropriate management of interest rate risk.

Currency risk

The Group undertakes transactions in foreign currencies from time to time, and, resulting from these activities, exposures in foreign currency arise. It is the Group's policy to hedge foreign currency trading transaction risks economically as they arise. To manage these exposures, the Group may use financial instruments such as forward foreign exchange contracts. At balance date, the Group had forward foreign exchange arrangements in place with a New Zealand dollar (NZD) fair value of $13k (2014: ($27k)).

The following table details the forward currency exchange contracts outstanding as at 30 June 2015 for the Group.

(See over page)

Currency risk *continued*

in thousands of New Zealand dollars	Average exchange rates		Foreign Currency		Notional Value		Fair Value	
	2015	2014	2015	2014	2015	2014	2015	2014
AUD								
Less than 3 months	0.9312	0.9178	240	310	262	338	(9)	4
CAD								
Less than 3 months	0.9098	0.9273	12	41	14	44	–	–
EUR								
Less than 3 months	0.6482	0.6188	63	160	100	264	(4)	2
3 to 6 months	–	0.5964	–	25	–	42	–	14
GBP								
Less than 3 months	0.4936	0.5070	22	28	50	55	–	1
JPY								
Less than 3 months	–	85.738	–	1,225	–	14	–	–
NOK								
Less than 3 months	–	5.1278	–	379	–	74	–	3
USD								
Less than 3 months	–	0.8562	–	123	–	143	–	3

The Group's exposure to foreign currency denominated non-derivative financial instruments was as follows, based on notional amounts:

in thousands of New Zealand dollars **30 June 2015**	AUD	EUR	USD	JPY	SGD	NOK	GBP	CAD	FJD
Cash balances	937	5	82	–	2	–	–	1	1
Trade receivables	253	16	189	–	–	–	–	–	–
Trade payables	(311)	(5)	(41)	–	–	–	(46)	–	–
Statement of financial position exposure	879	16	230	–	2	–	(46)	1	1

in thousands of New Zealand dollars **30 June 2014**	AUD	EUR	USD	JPY	SGD	NOK	GBP	CAD	FJD
Cash balances	760	11	214	5	4	1	84	–	111
Trade receivables	520	–	304	–	–	–	–	–	–
Trade payables	(517)	(299)	(139)	(18)	(48)	(70)	(72)	(39)	–
Statement of financial position exposure	763	(288)	379	(13)	(44)	(69)	12	(39)	111

The following significant exchange rates applied:

NZD	Reporting date spot rate	
	2015	2014
AUD	0.8871	0.9292
USD	0.6809	0.8757
NOK	5.3657	5.3688
SGD	0.9172	1.0932
EUR	0.6082	0.6418
JPY	83.27	88.71
CAD	0.8441	0.9348
GBP	0.4329	0.5143
FJD	1.4233	1.6056

A 10 per cent strengthening of the NZD against the following currencies at 30 June would have increased (decreased) the profit and the equity by the amounts shown below. This analysis assumes that all other variables, in particular interest rates, remain constant. The analysis is performed on the same basis for 2014.

in thousands of New Zealand dollars	2015	2014
AUD	(80)	(69)
EUR	(1)	40
USD	(21)	(34)
JPY	–	1
NOK	–	6
SGD	–	4
GBP	4	(7)
CAD	–	4
FJD	–	(10)

A 10 per cent weakening of the NZD against the above currencies at 30 June would have had approximately an equal but opposite effect on the above currencies to the amounts shown above, on the basis that all other variables remain constant.

NIWA has a regularly reviewed treasury policy in place which ensures the appropriate management of currency risk.

Liquidity risks

Liquidity risk represents the Group's ability to meet its contractual obligations. The Group evaluates its liquidity requirements on an ongoing basis. In general, the Group generates sufficient cash flows from its operating activities to meet its obligations arising from its financial liabilities and has credit lines in place to cover potential shortfalls.

The following table details the Group's contractual maturity analysis. The table has been based upon the earliest date on which the Group can be required to pay.

in thousands of New Zealand dollars **As at 30 June 2015**	On demand	Less than 1 year	Later than 1 year and not later than 5 years	Later than 5 years	Total
Payables and accruals	–	9,305	–	–	9,305
Employee entitlements	–	7,232	436	–	7,668
Total	**–**	**16,537**	**436**	**–**	**16,973**

in thousands of New Zealand dollars **As at 30 June 2014**	On demand	Less than 1 year	Later than 1 year and not later than 5 years	Later than 5 years	Total
Payables and accruals	–	12,713	–	–	12,713
Employee entitlements	–	8,681	488	–	9,169
Total	**–**	**21,394**	**488**	**–**	**21,882**

Financing facilities

The Group has access to financing facilities made available by ANZ Bank with a total value of $10.5 million (2014: $10.5 million). This was undrawn at 30 June 2015 (2014: nil). The total facility of $10.5 million relates to an overdraft facility of $0.5 million (on-call) and an overnight placement and short term advance facility of $10 million (2014: $10.0 million).

21. Leases

Leases are classified as finance leases whenever the terms of the lease transfer substantially all of the risks and rewards of ownership to the lessee. All other leases are classified as operating leases.

Operating lease payments are recognised on a systematic basis that is representative of the benefit to the Group (straight line).

in thousands of New Zealand dollars	2015	2014
Lease expense recognised in the year	2,201	2,182
Obligations payable after balance date on non-cancellable operating leases:		
Within 1 year	2,535	2,673
Between 1 and 2 years	2,073	2,121
Between 2 and 5 years	5,227	5,280
Over 5 years	3,470	5,158
	13,305	15,232

Operating leases relate to office and laboratory facilities within New Zealand and Australia with lease terms between 1 and 11 years, with various options to extend.

22. Capital commitments

in thousands of New Zealand dollars	2015	2014
Commitments for future capital expenditure		
Contracted, but not provided for	146	4,782

23. Changes in accounting policies

No changes in accounting policies were implemented during the year.

24. Contingent liabilities

There are no material contingent liabilities (2014: Nil).

25. Subsequent events

There are no subsequent events. (2014: A dividend of $4 million was declared by the Board of Directors on 20 August 2014).

Board and committee meeting attendance

The Board held twelve formal meetings and one special meeting during the year and also attended a Board strategy day. The Audit, Risk and Legislative Compliance Committee (ARLC Committee) held four meetings during the year. The table below shows director attendance at these Board meetings and committee member attendance at committee meetings. In addition, any director may attend any committee meeting.

Director	Board meetings	Special Board meetings	Board strategy day	ARLC Committee
Chris Mace *(Chairman)*	12	1	1	4*
Craig Ellison *(Deputy Chairman)***	11	1	1	4
Dr Helen Anderson	12	1	1	–
Prof. Keith Hunter	12	1	1	–
Prof. Gillian Lewis	10	1	1	–
Nicholas Main	12	1	1	4
Jason Shoebridge	12	1	1	4

* Mr Mace attends ARLC Committee meetings in an ex officio capacity.

** Mr Ellison's term as a director ended on 30th June 2015.

Directors' remuneration

The total remuneration received or receivable by directors of NIWA during the year was:

in thousands of New Zealand dollars	2015	2014
Chris Mace (Chairman)	72	72
Craig Ellison (Deputy Chairman)	45	45
Dr Helen Anderson	36	36
Prof. Keith Hunter	36	36
Prof. Gillian Lewis	36	36
Nicholas Main	36	36
Jason Shoebridge	36	36

Subsidiary company directors

The following people held office as directors of NIWA's subsidiary companies at 30 June 2015:

Subsidiary Company	Directors
NIWA Vessel Management Ltd	C Mace, C Ellison, H Anderson, K Hunter, G Lewis, N Main, J Shoebridge
Unidata Pty Ltd	B Cooper[1], B Biggs[1], D Saunders[2]
EcoConnect Ltd	J Morgan[1], P Baker[1]
NIWA Australia Pty Ltd	C Mace, C Ellison, H Anderson, K Hunter, G Lewis, N Main, J Shoebridge
NIWA Environmental Research Institute	C Mace, C Ellison, H Anderson, K Hunter, G Lewis, N Main, J Shoebridge
NIWA Natural Solutions Ltd	J Morgan[1], P Baker[1]

1. Employee of the Group's parent company
2. Representative of the minority ownership interest in Unidata Pty Ltd

No fees were paid in respect of membership of subsidiary boards.

Insurance for directors and employees

The NIWA Group has arranged insurance policies for directors and employees which, with a deed of indemnity, ensures that they will generally incur no monetary loss as a result of lawful actions undertaken by them as directors or employees. This insurance include, among others, directors and officers and professional indemnity policies. Certain risks are specifically excluded from the cover provided, including the imposition of penalties and fines in respect of breaches of the law.

Auditors

In accordance with Section 21(1) of the Crown Research Institutes Act 1992, the Group's auditor is the Auditor-General. The Auditor-General has appointed Jonathan Skilton of PricewaterhouseCoopers to conduct the audit on her behalf. Their audit remuneration and fees paid for other services are detailed in note 5.

Interests register

The following are transaction types recorded in the interests register for the year.

Interested transactions

Any business the NIWA Group has transacted in which a director has an interest has been carried out on a commercial 'arms-length' basis. Any potential conflict is recorded and minuted in Board meetings. An interests register containing all relevant directorships is updated on a monthly basis.

Directors' remuneration

Details of the directors' remuneration are provided in the 'Directors' remuneration' section above.

Use of company information by directors

Pursuant to section 145 of the Companies Act 1993 there were no recorded notices from directors requesting to use company information received in their capacity as directors that would not otherwise have been available to them.

Share dealings

During the year no director purchased, disposed of, or had recorded dealings of any equity securities of the NIWA Group.

Directors' loans

No loans by the NIWA Group to any director were made or were outstanding during the year.

Employees' remuneration

The number of employees (not including directors) whose total remuneration exceeded $100,000 during the year, stated in brackets of $10,000, was:

	2015
100,000–109,999	48
110,000–119,999	30
120,000–129,999	20
130,000–139,999	14
140,000–149,999	14
150,000–159,999	8
160,000–169,999	8
170,000–179,999	5
180,000–189,999	8
190,000–199,999	2
200,000–209,999	2
210,000–219,999	2
240,000–249,999	1
260,000–269,000	1
290,000–299,999	2
610,000–619,999	1

The remuneration reflected in the above table comprises base salary and at-risk salary components. This excludes payments in respect of superannuation or in respect of the cessation of employment of employees.

Remuneration exceeding $100,000 was received by 98 Science, 17 Science Support, 28 Management, and 23 Subsidiary staff. (2014: 97 Science, 16 Science Support, 26 Management, and 20 Subsidiary staff).

In 2014–15, the Group paid compensation or other benefits of $31,245 (2013-14: $101,867).

Donations

Donations of $2,357 were made during the year (2014: $2,300).

Dividends

A dividend of $4 million (2014: $2 million) was made to the Government of New Zealand as the sole shareholder.

STATEMENT OF RESPONSIBILITY

The following statement is made in accordance with section 155 of the Crown Entities Act 2004.

The Board of the Company is responsible for the preparation of these financial statements and the judgements used therein.

The Board of the Company is responsible for establishing and maintaining a system of internal controls designed to provide reasonable assurance as to the integrity and reliability of financial reporting.

In the opinion of the Board, these financial statements reflect a true and fair view of the financial position and operations of the Group for the year ended 30 June 2015.

Chris Mace
Chairman

Nicholas Main
Director

18 August 2015

To the readers of National Institute of Water and Atmospheric Research Limited financial statements for the year ended 30 June 2015

The Auditor-General is the auditor of National Institute of Water and Atmospheric Research Limited and its New Zealand domiciled subsidiaries and other controlled entities. The Auditor-General has appointed me, Jonathan Skilton, using the staff and resources of PricewaterhouseCoopers, to carry out the audit of the financial statements of the group, consisting of National Institute of Water and Atmospheric Research Limited and its subsidiaries and other controlled entities (collectively referred to as 'the Group'), on her behalf.

Opinion

We have audited the financial statements of the Group on pages 86 to 103, that comprise the statement of financial position as at 30 June 2015, the statement of comprehensive income, statement of changes in equity and cash flow statement 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 2015; and
  - its financial performance and cash flows for the year then ended; and
- comply with generally accepted accounting practice in New Zealand and have been prepared in accordance with New Zealand Equivalents to International Financial Reporting Standards and International Financial Reporting Standards.

Our audit was completed on 18 August 2015. 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 the financial statements for the Group that comply with generally accepted accounting practice in New Zealand and New Zealand Equivalents to International Financial Reporting Standards and International Financial Reporting Standards.

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.

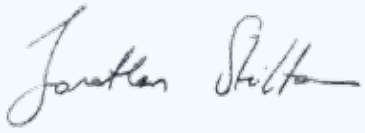
Responsibilities of the Auditor

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 section 15 of 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 have carried out assignments in the areas of ACC Partnership Program Review, which are compatible with those independence requirements. Other than the audit and these assignments, we have no relationship with or interests in the Group.



Jonathan Skilton
PricewaterhouseCoopers

On behalf of the Auditor-General
Auckland, New Zealand

pwc

National Institute of Water & Atmospheric Research Ltd

Directors

Chris Mace
Chairman

Craig Ellison
Deputy Chairman
(resigned 30 June 2015)

Nicholas Main
Deputy Chairman

Dr Helen Anderson

Prof. Keith Hunter

Prof. Gillian Lewis

Michael Pohio
(appointed 1 July 2015)

Jason Shoebridge

Executive Team

John Morgan
Chief Executive

Patrick Baker
Chief Financial Officer and Company Secretary

Geoff Baird
General Manager, Communications and Marketing

Dr Barry Biggs
General Manager, Operations

Dr Bryce Cooper
General Manager, Strategy

Dr Mary-Anne Dehar
General Manager, Human Resources

Dr Rob Murdoch
General Manager, Research

Andrew Watkins
General Manager, Information Technology

Registered office and address for service

41 Market Place
Auckland Central 1010
New Zealand

Auditors

PricewaterhouseCoopers on behalf of the Auditor-General

Bankers

ANZ Bank of New Zealand Ltd

Solicitors

Meredith Connell

Atkins Holm Majurey

Insurance broker

Marsh Ltd

Head office

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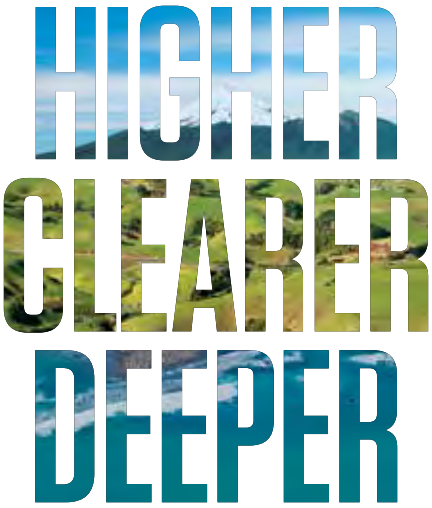
Dave Allen

NIWA's Māori name Taihoro Nukurangi describes our work as studying the waterways and the interface between the Earth and the sky. Taihoro is the flow and movement of water (from tai 'coast, tide' and horo which means 'fast moving'). Nukurangi is the interface between the sea and the sky (i.e., the atmosphere). Together, we have taken it to mean 'where the waters meet the sky'.

Rakaia River



NIWA
Taihoro Nukurangi

Enhancing the benefits of New Zealand's natural resources