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

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.

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

Terra Nova Bay,
Antarctica in late February as the sea starts to freeze.
Dave Allen
GOING
FURTHER
TOGETHER
Going Further Together – collaboration has been the hallmark of 2015/2016

We are always mindful of NIWA’s responsibility as New Zealand’s largest and pre-eminent provider of climate and atmosphere, freshwater and ocean science.

In a nation where our economy and way of life are primarily influenced by our climate, natural resources and biodiversity, having access to the best available science to inform decision making is essential.

A better understanding of changing climates and their impacts, having access to the right quantity and quality of freshwater and responding to competing demands for the use of marine resources, while protecting our natural environments, are not just New Zealand issues – they are among the most challenging issues facing the world.

Science of this nature requires highly skilled and experienced people, extensive infrastructure and scientific assets, and close collaborations with the global science community. Hence our focus in 2015/16 on continuing our investment in people and assets, and strengthening collaboration with other science providers – locally and internationally.

2015/16 was also a year during which several significant NIWA-related reviews were undertaken – often involving considerable input from NIWA staff. And it was a year in which a number of NIWA’s longer-standing contestable funding contracts with the Ministry for Business, Innovation & Employment (MBIE) expired, requiring new proposals to be prepared and submitted to secure new research funding.

This report will touch on some of these collaborations, reviews and funding impacts.
Science collaboration

While most New Zealanders were enjoying their summer holidays, some NIWA staff were far out at sea, in the middle of the Southwest Pacific Ocean, deploying floating robots from our research vessel Kaharoa. Their three-week voyage put nine Deep Argo floats into the ocean, where they float freely on the currents, measuring temperature and salinity between the surface and depths of up to 6000 metres.

The Deep Argo floats record measurements as they automatically descend to the sea floor, where they remain for 10 days, then resurface to transmit their data to a satellite before descending again. The Deep Argo floats are an extension of the international Argo project, which has about 4000 floats deployed around the world’s oceans, with the aim of providing a comprehensive picture of the oceans’ role in global climate, weather and climate-prediction systems.

At the same time Kaharoa was at sea, other NIWA staff were in Washington at an event to recognise and celebrate New Zealand’s collaboration with the United States science community, including the National Oceanic and Atmospheric Administration (NOAA) and the US Geological Survey (USGS). The collaboration between NIWA and the USGS is a cornerstone of the NZ–US science partnership, driving New Zealand’s involvement in US and international science projects. It is a testament to the regard in which New Zealand’s freshwater, marine and atmospheric science is held internationally.

"Argo is arguably one of the most ambitious and successful international marine research programmes ever undertaken. It would not exist if NIWA had not contributed to the deployment of floats, now well over 1000 in the sea today."

US oceanographer Dean Roemmich, NIWA’s Philip Sutton, and engineer Kyle Grindley from California prepare a Deep Argo float for deployment near the Kermadec Trench (L–R). Dave Allen
NIWA currently has more than 1000 active collaborations with other science providers around the world, from large, multinational organisations to individuals who are global leaders in their areas of expertise.

At the Washington event, Dr Steve Piotrowicz, NOAA’s Argo Program Manager, highlighted NIWA’s contribution to the project:

“Argo is arguably one of the most ambitious and successful international marine research programmes ever undertaken. It would not exist if NIWA had not contributed to the deployment of floats, now well over 1000 in the sea today.”

We are understandably proud of NIWA’s contribution to the Argo project. It illustrates the importance of science collaboration – putting together the best teams, gathering data and gradually building on the research and ideas of teams that have gone before. This is particularly so for NIWA as the science we are involved in becomes increasingly complex and interconnected and provides answers to questions of both global and national significance.

In fact, collaboration was a constant theme in NIWA’s achievements throughout the year – with other research organisations, local and central government agencies and industry. NIWA currently has more than 1,000 active collaborations with other science providers around the world, from large, multi-national organisations to individuals who are global leaders in their areas of expertise.

Historically, many in the science sector have defined collaboration by the extent to which funding has been shared with them; however, we believe strong collaborations come about as a result of a sharing of minds and capability. Having said that, during the last year NIWA spent $10.7 million with other science providers as subcontractors to assist with our science, whilst receiving $2.5 million in return.

With an eye to the future, earlier this year NIWA joined a New Zealand Innovation Mission to Israel led by Sir Peter Gluckman, Chief Science Advisor to the Prime Minister, and Simon Moutter, Chief Executive of Spark. The purpose of the mission was to learn from the world-leading Israeli innovation ecosystem, forge new business collaborations between New Zealand and Israel and develop ideas that could contribute to the unleashing of New Zealand’s potential.

In Washington to mark collaborative scientific endeavour between New Zealand and the US: David Dayton, NIWA Chief Executive John Morgan, Ed Gorecki, Nancy Cavallaro, Tom Hourigan and NIWA General Manager, Research Rob Murdoch (L–R).
The National Science Challenges

NIWA is hosting two of New Zealand’s eleven National Science Challenges and is a key partner in another three. The two challenges hosted by NIWA, Deep South and Sustainable Seas, made excellent progress during the year.

The aim of the Deep South challenge is to understand the role of Antarctica and the Southern Ocean in determining our climate and our future environment. Its mission is to produce solutions that will help the nation adapt to those climate changes. This year, significant progress towards this mission was achieved through the initiation of all the core research programmes and the allocation of contestable funds to novel science and to bring new scientists into the challenge. It has been especially exciting to see the establishment of a national earth systems modelling capability, which will form the cornerstone of the challenge’s science.

One of the key issues facing the nation is how we enhance our use of New Zealand’s vast marine resources, while ensuring that our marine environment is understood and cared for. That is the aim of the Sustainable Seas challenge. Its mission is to develop an ecosystem-based management tool to map interactions within ecosystems and with humans, so we can balance the use and conservation of resources.

This challenge also started all its core research programmes and allocated its contestable funds during the year. Māori and stakeholder engagement are key elements of Sustainable Seas, so it has been pleasing to see significant progress towards the co-development and integration of this aspect into the challenge’s science.

NIWA also contributed to the establishment of Resilience to Nature’s Challenges, hosted by GNS Science, the science of New Zealand’s Biological Heritage, hosted by Landcare Research and science leadership within AgResearch’s Our Land and Water.

Less frequently spoken about, but just as important, are the myriad contributions science institutes like NIWA make to the background of administration, communication, policy and education. For example, we helped develop a Regional Council Science Strategy document, and provided input to councils on the risks associated with national freshwater research capability and required amendments to the National Policy Statement for Freshwater Management.

A critical collaboration for NIWA is with tangata whenua. Central to that is Te Kūwaha, NIWA’s 13-strong Māori development and engagement team. This team works closely with iwi to incorporate science and mātauranga Māori, to maximise the value of their interests in agribusiness, fisheries, aquaculture and energy, and to help foster and develop young Māori scientists.

NIWA is the lead sponsor of six main city Science and Technology Fairs and an award sponsor of eight regional fairs, directly engaging with thousands of students, their parents and teachers.

The winners of this year’s NIWA Waikato Science and Technology Fair.
NIWA is particularly active in raising the constituency of science by encouraging student engagement and communication – identifying and promoting the role of science in society.

Science and education

NIWA remains committed to the development of our nation’s future environmental science capability through its contribution to the education sector.

The NIWA/University of Auckland Joint Graduate School in Coastal and Marine Science goes from strength to strength. Providing marine science students with the opportunity to be taught by and work with senior practising scientists enriches their knowledge and experience, and ultimately their future employment opportunities.

NIWA is also close to establishing a Joint Institute for Freshwater Management with the University of Waikato, once again with the aim of building future science capability and enriching the learning experience of students. The complementary nature of NIWAs and the University of Waikato’s freshwater science capability will be of immense value to New Zealand at a time when the focus on sustainable use of our freshwater resources is growing.

This year, NIWA’s senior scientists supervised 79 PhD or MSc students at the universities of Auckland, Otago, Canterbury, Victoria and Waikato. We also trialled a summer internship programme, funding three students on 15-week internships (two in Auckland and one in Hamilton).

NIWA is particularly active in raising the constituency of science by encouraging student engagement and communication – identifying and promoting the role of science in society. In a continuation of our growing partnership with the Sir Peter Blake Trust, this year we provided four NIWA Blake Ambassadors with unique opportunities to work alongside our science teams – experiences they subsequently use as a foundation for inspiring and educating others. We also lead support of the Science New Zealand-sponsored Sir Paul Callaghan Eureka Awards to identify and foster young leaders in science, and this year added a NIWA Scholarship Award focused on the Sustainable Seas National Science Challenge.

Sir Peter Blake Trust Chief Executive
Shelley Campbell, NIWA Chief Executive
John Morgan and trust representatives
We were pleased the review panel found NIWA to be a well-managed, high-functioning organisation which takes its Statement of Core Purpose obligations and outcomes seriously.

Four Year Rolling Review of NIWA

This year the Executive Team and Board were actively engaged in several government reviews that were important to the future of the science sector and NIWA. One of the more significant of these was the MBIE Four Year Rolling Review of NIWA – a process that provides shareholding ministers with an independent assessment of each Crown Research Institute’s (CRI) current effectiveness and future potential. The reviews provide insights into where performance can be improved and assurance on whether the CRI is operating effectively in delivering outcomes that contribute to New Zealand’s economic, social and environmental wellbeing.

We were pleased the review panel found NIWA to be a well-managed, high-functioning organisation which takes its Statement of Core Purpose obligations and outcomes seriously. We note the review panel’s positive suggestions to further enhance our performance. The report noted that NIWA consistently met its objectives, had sound governance processes, and produced high quality science aligned with its Statement of Corporate Intent and five-year strategic outcomes. The panel, while noting that NIWA met its customers’ expectations overall, made suggestions to formalise the management of customer relationships and timeliness of science project delivery. They found NIWA’s financial and human resources systems and processes, and health and safety practices, were very strong and embedded throughout the organisation.

Collaboration was also raised by the panel, and it was gratifying that their report noted NIWA’s active collaboration with other researchers, industry and central and local government. Our Te Kowaha programme to improve engagement with Māori enterprise was also recognised.


NIWA’s flagship research vessel Tangaroa.
Dave Allen
Government commitment to science and innovation

We were pleased to see the Government’s ongoing commitment to science, as illustrated by the announcements in its 2016 Budget, which has been described as the most positive budget for the science sector in decades.

The substantial increase in science funding will give institutions like NIWA the confidence to continue investing in the world-class capability needed to produce the knowledge that evidence-based decision making demands.

In NIWA’s case, this has enabled us to maintain and build our freshwater capability for the nation, plan for more scientific use of the research vessel Tangaroa, and maintain a number of nationally significant biological collections and databases.

The 2016 Budget provided an additional $5.9 million for NIWA’s Strategic Science Investment Funding (formerly Core Funding) to replace expiring five-year MBIE contestable freshwater funding contracts; new funding of $1.5 million per year for the next four years for scientific use of Tangaroa, with an additional $2 million every second year for Antarctic voyages; and new funding of $0.7 million per year towards the maintenance of NIWA's national biological collections and databases.
A very pleasing result

Despite considerable uncertainty over revenue during the year, particularly from the National Science Challenges and MBIE contestable funding which were collectively $10.5 million below budget, we managed to grow revenue from other sources, maintain tight control of costs and achieve the budgeted profit for the year.

In this context, our results for the year were very pleasing.

Revenue was $130.4 million against a budget of $137.0 million, profit before tax was $5.5 million and net profit after tax (NPAT) was $4.0 million, both measures being $0.3 million above budget.

Earnings before interest, tax, depreciation and amortisation (EBITDA) was $19.8 million, and the adjusted return on average equity after tax was 4.7%, against a budget of 4.5%.

Health and safety performance

Maintaining the health and safety of NIWA staff and those we work with remains the number one priority for NIWA, particularly given the challenging environments within which much of our work is conducted.

All aspects of NIWAsafe – our initiative to focus on our pathway to zero harm – have been reviewed and tested over the past year. This constant process of reviewing and revising our health and safety processes, procedures and attitudes is one way of avoiding complacency with this critical aspect of our operations. The focus has paid off in staff awareness, with health and safety being the highest scoring section in this year’s staff survey, a further increase on the results of the previous survey two years ago.

While it has been encouraging to see the number of injuries remain relatively low this year, and the severity of injuries reduced once again, we still have work to do to eliminate them entirely.

During the year a comprehensive Marine Safety Authority audit was undertaken by Maritime New Zealand for all NIWA’s land-based vessels. Preparation for this audit involved the establishment of a new and comprehensive NIWA Maritime Transport Operator Plan which has been under development for the last two years.

The outcome of the audit led to NIWA obtaining a Maritime Transport Operator Certificate. We were pleased with Maritime New Zealand’s comment that NIWA was an exemplar when assessing our maritime safety plan, practices and culture.

NIWA’s Andrew Willsman, Jeremy Rutherford and Eric Stevens working on upgrades to the Mount Larkins climate station.

Ginny Sutton
Science highlights

NIWA’s 2015/16 Statement of Corporate Intent had 64 key performance indicators to evaluate the progress of our science strategies and objectives over the past year. These are reported on later in this report, but there are some highlights worth noting here.

Higher – Climate and Atmosphere

Among the hundreds of science projects in our climate and atmosphere research programmes, there were three significant climate-related events this year – confirmation that the void in the ozone hole over Antarctica is shrinking, NIWA’s report projecting New Zealand’s future climate, and the warmest six months start to a year on record.

A generation of NIWA scientists contributed to the research behind the historic announcement of the shrinking ozone hole. Although the hole will not close completely until mid-century at the earliest, the healing is reassuring to scientists who pushed for the Montreal Protocol, the 1987 international agreement which phased out the industrial production of chlorofluorocarbons.

NIWA plays a major role in monitoring atmospheric ozone from its research sites at Lauder in Central Otago and Arrival Heights in Antarctica.

A new climate projection report, written by NIWA scientists, was released by the Ministry for the Environment (MfE) in 2016. Analysis of daily output data from the regional climate models indicated increases in extreme weather events. For example, heavy rainfall and drought severity are both likely to increase in many areas of the country.

The variability and driving force of New Zealand’s weather steadily increases public demand for NIWA’s summaries of climatic conditions and outlooks for the coming season. Our meteorologists and forecasting team are in particular demand, especially as New Zealand experienced its hottest six month start to a year in recorded history. Our monthly summaries and seasonal outlooks are keenly received by those managing climate- or weather-affected businesses or events, as well as by the general public and the media.

**Drought takes hold.**
Dave Allen
Clearer – Freshwater

The quality of New Zealand’s freshwater has become a barometer of environmental and community health. While there are areas that need attention, our water quality overall is high compared with that in the rest of the world. New Zealanders are determined to keep it that way, and NIWA works across the board, from modelling the whole cycle of water through our environment, to monitoring freshwater quality and quantity and providing solutions for the treatment or disposal of wastewater.

The National Policy Statement for Freshwater Management (NPS-FM) requires regional councils to establish objectives and set limits for freshwater use. NIWA had its busiest year on record contributing to water quality monitoring, assessment and information.

The M&IE Science Review Panel for the NPS-FM is chaired by a NIWA Chief Science Advisor, and scientists from NIWA’s National Freshwater Science Centre served on expert panels on macroinvertebrates, sediment, dissolved oxygen/water temperature and freshwater fish – contributing to dozens of research reports for MIE and regional councils.

NIWA has developed a model of all New Zealand river catchments, a major step towards understanding the nation’s water resources. The model, TopNet, is a good example of the integration of climate science and hydrology at NIWA, with better flow estimation arising from improvements in rainfall forecasting. It is being used to investigate the impact of land-use changes and to explore the likely effects of climate variability and change on hydroelectricity generation and water resource availability. This year, four regional councils started using TopNet for a variety of purposes in their region.

We are also working on cleaning up wastewater. We started a high rate algal pond wastewater treatment system at Cambridge with the Waipa District Council, and Environment Bay of Plenty is piloting one of our systems on a dairy farm at Katikati. It grows algae to recover farm dairy effluent nutrients prior to effluent irrigation.

The dream of a perfect tool to help with water allocation decisions is nearing realisation. Four regional councils are currently trialling our environmental flows strategic allocation platform, which helps large-scale water management by balancing out-of-stream benefits against in-stream values. A catchment-scale version, the cumulative hydrological effects simulator, was trialled this year in the Grey River catchment with the West Coast Regional Council.

Deeper – Coasts and Oceans

Much of who and what we are as a nation is characterised by our position in the middle of the Southwest Pacific Ocean, surrounded by one of the world’s largest marine realms. Our reliance on our coasts and oceans has also driven NIWA’s internationally renowned capability in science above, on, in and under the water.

Aquaculture catches popular attention for its economic possibilities and for its potential environmental impacts. Mussel and salmon farming are well established, and work continues on optimising their production. NIWA research this year looked at improvements in oxygen levels and nutrients around aquaculture farms, and on feed formulations and pen management.

Maruia Falls at dusk.
Nava Fedaeff
NIWA has developed a model of all New Zealand river catchments, a major step towards understanding the nation’s water resources.

NIWA’s research and development in recent years on the culture of new, high-value finfish species, notably yellowtail kingfish and hāpuku, has made good progress over the past year. We are now at the stage where yellowtail kingfish is ready for commercialisation, and the next phase is to assess the practicalities of establishing a commercial recirculating aquaculture system for this species at our Northland Marine Research Centre. The next phase for the hāpuku research is to address the biological impediments to scaling up fingerling production to sustainably support a commercial operation.

NIWA is at the forefront of an intense focus by the international science community on the acidification of the world’s oceans as they increasingly absorb carbon dioxide from the atmosphere. A major part of this global effort is the New Zealand ocean acidification observing network, which has expanded to 14 coastal sampling stations, with seasonal data having been analysed for 11 sites.

NIWA has been studying ocean carbon chemistry in the waters off Otago since 1998, creating an important time-series of observations. We have also studied and reported on acidification factors in the inner Hauraki Gulf which led to enhanced biogeochemical modelling of deoxygenation and acidification in the Gulf. The Gulf was also the site of an even more exhaustive study into changes to the marine food web since the first human settlement.

NIWA’s fishery expertise is in demand internationally as well as being fundamental to much of New Zealand’s globally recognised Quota Management System, which celebrated its 30th anniversary in 2016. This year, we completed the first of two seasonal surveys of fish resources of the United Arab Emirates for Environment Abu-Dhabi. NIWA teams also helped in the development of deepwater snapper and bluenose fisheries for Tonga, and conducted toothfish fishery surveys and assessments of the Ross Sea.

Meanwhile, the multibeam echosounder on Tangaroa was again in considerable demand. In more than 120 days at sea, we mapped 40,000 km² of seafloor for oceanic and coastal surveys funded by MBIE and contracted work from the oil and gas sector and regional authorities. Two surveys in coastal marine reserves were also undertaken to boost management capability in these high-value regions. This information will be integrated with legacy data in NIWA’s bathymetry database to extend the mapped area within the New Zealand EEZ.

Orange-spotted grouper, an important commercial species in the UAE.
Best people, best skills, best outcomes

We would like to specifically acknowledge the resourcefulness and commitment of our people throughout the organisation. In what was a demanding year in many respects, they rose to the challenge – earning new revenue, carefully managing expenditure, and continuing to produce the outstanding research and applied-science services for which NIWA is recognised.

Much of their willingness can be attributed to a can-do attitude and the agility that has become a cornerstone of the way we operate. It was gratifying to note the 2016 NIWA Staff Survey results, which were the most positive recorded in 10 years – in particular the improvement in the staffs’ rating of their sense of common purpose, pride and satisfaction.

In this report we acknowledge a number of our people who particularly rose to the challenges and were recognised at the 2016 NIWA Excellence Awards ceremony.

We would also like to thank the Board and the Executive Team for their support and efforts over what was a challenging year, with an ultimately pleasing outcome.

The attitude and skills of our staff will stand us in good stead again over the next 12 months, as we strive to enhance our position as this nation’s pre-eminent provider of freshwater, coasts and oceans, and climate and atmospheric science.

Sir Christopher Mace, KNZM
Chairman

John Morgan
Chief Executive

“The Fishes of New Zealand”

In November 2015 Te Papa Press published “The Fishes of New Zealand”, a four-volume, 1800 page encyclopaedic guide bringing together more than 20 years of fish collection, collaboration and research of world-renowned fish experts.

During the launch at Te Papa, John Morgan spoke of NIWA and Te Papa’s long history of scientific collaboration that had resulted in the publication of this outstanding text, which describes all 1265 known New Zealand fish species, along with illustrations, maps and drawings.

NIWA was proud to be part of an important cooperative publishing achievement that advanced knowledge and understanding of the extraordinary range of fish found in New Zealand waters. We contributed through our core funding capabilities as well as by providing text, images, research and specimens, many of which were collected on voyages undertaken by NIWA vessels.

In September 2016 “The Fishes of New Zealand” was awarded the 2016 Whitley Medal for outstanding publication in Australasian zoology – regarded as Australia’s highest award for zoological publishing – the first time it has been awarded to a New Zealand book.

The Editorial team at the Te Papa launch with Minister of Conservation Hon. Maggie Barry.
FINANCIAL SUMMARY

NIWA Group Financial Summary
For the year ended 30 June 2016

<table>
<thead>
<tr>
<th>In thousands of New Zealand dollars</th>
<th>2016</th>
<th>2015</th>
<th>2014</th>
<th>2013</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue and other gains</td>
<td>130,373</td>
<td>126,259</td>
<td>123,539</td>
<td>120,680</td>
<td>121,304</td>
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<tr>
<td>– Research</td>
<td>68,896</td>
<td>64,075</td>
<td>65,176</td>
<td>62,739</td>
<td>62,358</td>
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<tr>
<td>– Applied science</td>
<td>61,412</td>
<td>62,115</td>
<td>58,221</td>
<td>57,820</td>
<td>57,384</td>
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<tr>
<td>– Other income</td>
<td>65</td>
<td>69</td>
<td>142</td>
<td>121</td>
<td>1,562</td>
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<tr>
<td>Profit before income tax</td>
<td>5,492</td>
<td>8,005</td>
<td>7,324</td>
<td>6,581</td>
<td>7,450</td>
</tr>
<tr>
<td>Profit for the period</td>
<td>4,011</td>
<td>5,755</td>
<td>5,278</td>
<td>4,640</td>
<td>5,541</td>
</tr>
<tr>
<td>Capital expenditure</td>
<td>12,592</td>
<td>15,652</td>
<td>10,852</td>
<td>11,360</td>
<td>8,393</td>
</tr>
<tr>
<td>Adjusted return on average equity (%)</td>
<td>4.7</td>
<td>7.0</td>
<td>6.7</td>
<td>6.2</td>
<td>7.9</td>
</tr>
<tr>
<td>Return on average equity (%)</td>
<td>3.7</td>
<td>5.5</td>
<td>5.2</td>
<td>4.7</td>
<td>5.8</td>
</tr>
</tbody>
</table>

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.

Group actual performance versus Statement of Corporate Intent (SCI)
For the year ended 30 June 2016

<table>
<thead>
<tr>
<th>in thousands of New Zealand dollars</th>
<th>Actual 2016 $</th>
<th>SCI 2016 $</th>
<th>Actual 2015 $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue and other gains</td>
<td>130,373</td>
<td>137,038</td>
<td>126,259</td>
</tr>
<tr>
<td>Operating expenses, depreciation, and amortisation</td>
<td>125,352</td>
<td>131,987</td>
<td>118,649</td>
</tr>
<tr>
<td>Profit before income tax</td>
<td>5,492</td>
<td>5,202</td>
<td>8,005</td>
</tr>
<tr>
<td>Profit for the period</td>
<td>4,011</td>
<td>3,744</td>
<td>5,755</td>
</tr>
<tr>
<td>Average total assets</td>
<td>141,150</td>
<td>139,696</td>
<td>136,754</td>
</tr>
<tr>
<td>Average shareholders’ funds</td>
<td>107,370</td>
<td>106,347</td>
<td>104,505</td>
</tr>
</tbody>
</table>

Profitability

| Operating profit margin (%) (EBITDA/revenue) | 15.2 | 15.1 | 17.4 |
| Adjusted return on average equity after tax (%) (net surplus/adjusted average equity) | 4.7  | 4.5  | 7.0  |
| Return on average equity after tax (%) (net surplus/average equity) | 3.7  | 3.5  | 5.5  |
| Return on assets (%) (EBIT/average total assets) | 3.6  | 3.6  | 5.6  |
| Profit volatility (%) (non-adjusted ROE) | 6.4  | 4.1  | 10.1 |
| Forecasting risk (%) | 1.0  | 2.2  | (0.3) |

Liquidity and efficiency

| Current ratio | 1.6 | 1.5 | 1.5 |
| Quick ratio   | 2.2 | 1.9 | 2.1 |

Financial leverage

| Debt to average equity (%) | –   | –   | –   |
| Gearing (%)               | –   | –   | –   |
| Proprietorship (%) (average shareholders’ funds/total assets) | 73  | 76  | 76  |
NIWA faced down some significant challenges during the year, allowing it to grow its revenue and achieve its key profitability objectives.

Revenue
NIWA is pleased to report revenue of $130.4 million for the year, an overall increase in revenue compared with the prior year of $4.1 million, despite a number of significant headwinds faced by the Company during the year.

FY16 saw a continued decline in NIWA’s ability to secure contestable funding to conduct freshwater research, funding for which was not included as a component of Core revenue when that programme was established. The reduction of $1.6 million for FY16 combined with a reduction of $3.2 million during the prior year to drive a two year reduction in this research funding of $4.8 million.

However, as these declines represented an unintended consequence of recent changes to the science funding system, NIWA was pleased to see funding for freshwater research restored through the Strategic Investment Fund announced as part of the Government’s Budget 2016.

During the prior year the reduction in Contestable freshwater funding was masked by NIWA’s success in winning one-off sea bed surveying contracts supporting the minerals exploration industry and conducted from NIWA’s flagship research vessel Tangaroa. As expected, however, commercial vessel charters returned to a more typical level during FY16, accounting for a reduction in revenue of $7.8 million compared with the prior year.

The National Science Challenges, two of which are hosted by NIWA, picked up momentum during the year, accounting for a year on year increase in revenue of $4.5 million – although of this $3.1 million was accounted for by revenue passed on to collaborators within those Challenges, leaving a year on year increase of $1.4 million to support NIWA’s research activities.

Additionally, NIWA was successful in winning an additional $3.0 million in applied science work carried out on behalf of the Ministry of Primary Industries (including voyages undertaken by Tangaroa) and over $4 million in other commercial work.

Compared with the Budget set out in NIWA’s Statement of Corporate Intent, revenue was down by $6.7 million. This was more than accounted for by $9.9 million lower than budget research revenue due to slower than expected launch of the National Science Challenges combined with the Contestable funding issue discussed above. This reduction was partly offset by better than budget performance in securing commercial contracts.

Year-on-year, the share of NIWA’s revenue arising from transactions with its key central government clients MBIE and the Ministry for Primary Industries, rose by 4% to 67%. This was due to increases in revenue associated with the National Science Challenges and for projects undertaken for the Ministry for Primary Industries combined with the reductions in revenue from commercial vessel charters noted above.
Expenditure
Operating expenses (including depreciation and amortisation) increased by $6.7 million compared with the prior year, this increase being primarily accounted for by two factors. Firstly, the amount of revenue passed through to subcontractors associated with the National Science Challenges increased by $3.1 million year on year, as these Challenges gathered momentum. Secondly, personnel expenses also increased by $3.1 million.

This increase was partly due to filling positions vacant from the prior year, ensuring that our science capability continues to be maintained at a world class standard. Also, recognising that the expertise and commitment of its people are key to the Company’s success, a strategy of remunerating staff at or above market rates was continued and resulted in carefully considered increases to staff remuneration.

Total costs were down by $6.6 million compared with the budget for the year. Of this reduction, $3.8 million resulted from lower revenues being passed through to collaborators associated with the National Science Challenges. The balance of the reduction resulted from NIWA’s swift action to control costs in the light of lower revenues, ensuring that overall financial sustainability can be maintained. Of this, $1.9 million reflected lower than budget personnel costs.

Profitability
As was anticipated in the budget, costs grew by more than revenue compared with the prior year as NIWA worked to build its science capability in key areas while ensuring its staff remained competitively remunerated. However despite the significantly lower than budget revenue performance, cost reductions (compared with budget) that more than matched the reduced revenue. This resulted in profit before tax of $5.5 million and profit after tax of $4.0 million, both $0.3 million better than budget.

NIWA’s fundamental financial performance metric is adjusted return on equity, which enables comparison between CRLs on an equivalent basis. The Company delivered an adjusted ROE of 4.7% this year, down from 7.0% last year and 0.2% better than the budget objective.
CAPITAL MANAGEMENT AND CASH

Cash flows
The following table summarises NIWA’s cash flows ($ in millions) this year and last year:

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2015</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net cash flows from operating activities</td>
<td>23.061</td>
<td>16.736</td>
<td>6.325</td>
</tr>
<tr>
<td>Net cash flows from investing activities</td>
<td>(12.192)</td>
<td>(15.574)</td>
<td>3.382</td>
</tr>
<tr>
<td>Net cash flows from financing activities</td>
<td>0.0</td>
<td>(4,000)</td>
<td>4,000</td>
</tr>
<tr>
<td>Net increase/ (decrease) in cash</td>
<td>10,869</td>
<td>(2,838)</td>
<td>13,707</td>
</tr>
</tbody>
</table>

Net cash flows from operating activities
Net cash inflows from operating activities increased by $6.3 million to $23 million in 2016. The most significant driver of this year-on-year change was funding received from MBIE associated with the National Science Challenges in advance of those Challenges fully completing the associated work projects. Such funding is recognised as a liability on the balance sheet (‘revenue in advance’).

Net cash flows from investing activities
Net cash outflows from investing activities decreased by $3.4 million to $12.2 million. This year-on-year variance is more than explained by the unusual item in the prior year, being the purchase of land and buildings at NIWA’s Northland Marine Research Centre in Bream Bay.

Net cash flows from financing activities
Net cash outflows from financing activities decreased by $4.0 million to zero due to the Company paying no dividend during the year. This was previously signalled in the Statement of Corporate Intent, and reflects upcoming essential and material investments designed to ensure that its science facilities remain fit for purpose for the coming decades.

Capital spending
The following table summarises NIWA’s capital expenditure ($ in millions) this year and last year:

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2015</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land, buildings &amp; improvements</td>
<td>0.740</td>
<td>5.294</td>
<td>(4.554)</td>
</tr>
<tr>
<td>Equipment</td>
<td>7.740</td>
<td>5.553</td>
<td>2.187</td>
</tr>
<tr>
<td>ICT equipment</td>
<td>1.153</td>
<td>2.815</td>
<td>(1.662)</td>
</tr>
<tr>
<td>Vessel equipment</td>
<td>2.059</td>
<td>1.501</td>
<td>0.558</td>
</tr>
<tr>
<td>Other</td>
<td>0.870</td>
<td>0.489</td>
<td>0.381</td>
</tr>
<tr>
<td>Total capital spending</td>
<td>12.592</td>
<td>15.652</td>
<td>(3.060)</td>
</tr>
</tbody>
</table>

Total capital expenditure was $12.6 million during the year, down from $15.7 million during the prior year for the reasons noted above.

Capital structure and liquidity
Shareholders’ equity at 30 June 2016 was $109.3 million which was $1.2 million higher than the level forecast in the SCI budget (2015: $108.1 million). Total assets at year-end were $147.1 million (2015: $135.2 million). As at 30 June 2016, the Company’s net debt balance was zero, equal to that at the prior year-end.

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 published 2015/16 Statement of Corporate Intent, the Directors of NIWA have decided not to declare a dividend in respect of the 2016 year. This is in the 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 continued development at the Northland Marine Research Centre at Bream Bay.
NIWA’s most significant investments (over $250k) during the year included:

$296k
Ocean glider
NIWA’s ocean gliders have revolutionised the way ocean observations are made. These autonomous underwater vehicles collect data – temperature, salinity, pressure, oxygen, light and turbidity – at higher spatial and temporal resolution than collected traditionally by research vessels, and at a fraction of the cost of ship time.

$490k
Passive acoustic monitoring equipment
In what was a first for New Zealand, marine ecologist Dr Kim Goetz used acoustic monitoring equipment to record the ambient soundscape – particularly whales and dolphins – of Cook Strait. The purpose is to increase understanding of the many different species found there, their migration pathways and behaviour.

This unique equipment will enable NIWA to offer new innovative services to many different customers, including the Department of Conservation, regional councils and the oil and gas and seabed mineral sectors.

$333k
The measurement equipment pool
NIWA invests significantly each year to ensure its measurement equipment is world-class and our scientists and customers have the best available data. Investment over the last year included transponders, current meters, sensors and another underwater camera.

$271k
McLane moored profilers
The new MMP, operated by technician Mike Brewer (right), autonomously profiles the water column in a time-series along a fixed tether. These profilers have many potential uses, including research as part of the Sustainable Seas National Science Challenge, and will enhance our understanding of how energy is transformed in the shelf-break ocean.

$648k
Climate network extension
NIWA continues to invest in its climate station network to provide increasingly accurate and localised forecasting data to weather-dependent businesses, particularly the rural sector. Principal technician Andrew Harper (left) spearheads this operation, which includes sophisticated weather stations and specialised tools such as InMet, which help farmers decide when to irrigate of fertilise.
NIWA IN A NUTSHELL
Enhancing the benefits of New Zealand’s natural resources

Core purpose

- Enhance the economic value and sustainable management of New Zealand’s freshwater and marine resources and environments
- Improve our understanding of the atmosphere and New Zealand’s climate
- Increase resilience to weather and climate hazards to improve the safety and wellbeing of New Zealanders

Science strategies

Climate and Atmosphere
- Improve our understanding of the changing climate to enable adaptation to its impacts
- Contribute to global understanding of atmospheric composition and dynamics
- Improve forecasting to reduce the impact of weather - and climate - related hazards
- Produce environmental forecasts tailored to weather-dependent sectors and customers

Data Services
- Collect, quality assure and curate nationally significant environmental data
- Efficiently deliver environmental data and information to stakeholders at an appropriate price
- Develop value-added, data-based products and services

Freshwater
- Improve our understanding of New Zealand’s freshwater quantity and quality
- Maximise sustainable use of New Zealand’s water resources for economic benefit
- Support the implementation of the Government’s freshwater reforms

Coasts and Oceans
- Improve our understanding of New Zealand’s marine environment to inform decisions about its management
- Maximise sustainable use of New Zealand’s marine resources for economic benefit
- Develop new finfish aquaculture species to grow the industry in New Zealand

Enabling strategies

Safety
Zero harm to our people and those who work with us

Science excellence
Globally recognised and respected; objective and most trusted by stakeholders

Facilities and assets
Modern facilities, infrastructure and state-of-the-art science equipment and methods

Māori engagement
Respected value-adding collaborator and commercial partner of Māori enterprises

Agility
Adaptable, responsive, opportunistic and embrace change

IT
Contemporary IT infrastructure and tools to deliver efficient and value-added services

People and leadership
Best scientists, technicians and support staff – the “employer of choice”

Customer focus
Keep promises, communicate well, deliver on time, within budget and to specification

Productivity
Most cost-effective and efficient with resources, time and service delivery

Communication
Most respected and trusted brand, with innovative messaging tailored to audiences
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.

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.

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.

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.
Hot Spot Watch – a drought indicator

From the middle of last year NIWA’s weather forecasters were consistently warning of a developing El Niño that was likely to be among the strongest experienced in the past century.

Previous strong El Niños in 1982/83 and 1997/98 resulted in widespread drought in New Zealand. With this in mind, NIWA began issuing its weekly report, Hot Spot Watch, in September, two months ahead of schedule. Hot Spot Watch, which uses data from NIWA’s network of climate stations processed by its supercomputer, updates soil moisture across the country to help assess developing dry conditions.

Each weekly update included soil moisture anomaly maps and was widely published by media and sought after by government officials in the agricultural sector.

We also provided regular updates on El Niño for the Prime Minister’s Chief Science Advisor, Sir Peter Gluckman, and to the Ministry for Primary Industries’ (MPI) National Adverse Events Committee. In addition, NIWA climate scientists gave briefings to farmers on how El Niño was expected to develop.

This led to MPI funding the establishment of a new NIWA drought monitoring index, published on the NIWA website, which combines soil moisture levels, dryness and rainfall into one scale. The easily understood index is updated regularly and includes a threshold for drought.

With New Zealand experiencing warmer than average temperatures this year, the new index will provide additional insight into our changing climate.

Winter drought, Methven, Canterbury.
Dave Allen
Forecasting services for the public and businesses

The addition of two internationally experienced meteorologists and the acquisition of software to help aggregate and analyse weather and climate data enabled NIWA to substantially expand its forecasting services during the year.

New contracts for the provision of tailored forecasting services, delivered using a variety of channels including video, online, written and verbal, were negotiated with several businesses. The highly localised and customisable nature of NIWA’s forecasts gives commercial clients significant competitive advantage. These forecasts can be compiled and presented in different ways to meet the specific needs of differing audiences or stakeholders.

NIWA’s free public forecasting and information service also expanded and evolved during the year. Daily weather briefs were introduced to the NIWAWeather website, supported by striking infographics and video forecasts when significant weather events threatened.

The public was also kept informed by increased activity on NIWAWeather’s media and social media channels, using information from a new analysis tool that provides scientists with fingertip access to national climate records across all timescales.

Digitisation of NIWA’s regular climate summaries and seasonal outlooks was another significant advancement.

Media organisations and other users of this information now receive self-contained videos and infographics that tell New Zealand’s climate stories in a clear and compelling way. These items were posted on major national news websites and disseminated to other key users using NIWA’s media and social media networks.

Reporting a greenhouse gas milestone

Since 1972, NIWA has operated a Clean Air Monitoring Station at Baring Head, near Wellington.

The data collected there make significant contributions to the global understanding of greenhouse gases and are the longest-running continuous record of atmospheric carbon dioxide in the Southern Hemisphere.

In June, Baring Head’s carbon dioxide readings officially passed 400 parts per million (ppm), a level last reached more than three million years ago.

The 400ppm level was reached earlier in the Northern Hemisphere, but the Baring Head reading means enough gas has now mixed through the atmosphere and reached the high latitude Southern Hemisphere stations. Baring Head is particularly significant because the air arriving there originates far to the south, away from human activities.

The milestone reading at the NIWA station attracted international media attention with NIWA atmospheric scientists called on to explain the significance.

Globally, the 400ppm threshold represents an atmospheric landmark as a focus for the urgency of a change in human activity.

Clean Air Monitoring Station Baring Head, Wellington.
Dave Allen
Weather diaries

History and science collided earlier this year with the publication of a paper by NIWA scientists about the discovery of the diaries of an early English missionary living in Northland in the 1800s.

The diaries, written by Rev. Richard Davis and held at the Auckland Public Library, could be the earliest continuous land-based meteorological measurements made in New Zealand. They predate records kept in the early to mid-1850s by the Royal Engineers in Auckland by at least a decade.

The paper examines the scientific value of the data and was published in international scientific journal Climate of the Past. Rev. Davis is called New Zealand’s first meteorologist because of the length and detail of data he kept.

The data indicated that most of the increased methane was being produced by bacteria, of which the most likely sources were natural, such as wetlands, or agricultural. Previous studies had determined that the methane originated from an area that includes Southeast Asia, China and India – areas dominated by rice production and livestock agriculture.

Those studies enabled the scientists to conclude that agriculture was likely to be the dominant source of increased methane in the atmosphere.

Japanese rice paddies.

The rise in atmospheric methane

In March 2016, NIWA scientists made a major international contribution to understanding the causes of climate change, with the publication of a study in the prestigious international journal Science.

The research, led by NIWA atmospheric scientist Dr Hinrich Schaefer, ruled out fossil fuel production as the major cause in rising methane levels in the atmosphere since 2007, finding they were most likely dominated by agricultural practices.

New trends were first noticed in the data collected at NIWA’s clean air monitoring stations at Baring Head in Wellington and Arrival Heights in Antarctica.

The scientists then collaborated with US and German colleagues taking similar measurements in a number of locations across the world with the aim of calculating a global average for each year and determining how that had changed over time.

They observed a plateau in the amount of methane in the atmosphere between 1999 and 2006 before it began to rise again. Based on chemical markers, so-called isotopes, Dr Schaefer said they were then able to distinguish between three types of methane emissions: burning organic material, fossil fuel production and bacterial processes.

During Rev. Davis’s time. He recorded the temperature each day at 9am and noon, and also took a midday pressure measurement. He also commented on wind flow, wind strength and cloud cover and made notes about extreme weather events. The diaries cover nine years of weather observations in two parts: from 1839 to 1844 and from 1848 to 1851. Interestingly, there are two accounts of snow in Northland.

The diaries are expected to make a significant contribution to an international collaboration that recovers and digitises historical weather observations. The data will also be added to the 20th Century Reanalysis Project, which aims to reconstruct six-hourly snapshots of the weather conditions across the globe.
The physics discovery of the century

NIWA’s atmospheric research station at Lauder in Central Otago recently played a key part in what has been labelled “the physics discovery of the century”.

In September, scientists based at two US observatories witnessed gravitational waves arriving at Earth from a cataclysmic event in the distant universe. The robotic BOOTES-3 telescope installed at Lauder was the only instrument in the world to simultaneously record the optical component of this first-ever observation of gravitational waves.

Physicists have concluded that the detected gravitational waves were produced during the final stages of a merger of two black holes. This collision also resulted in a burst of gamma rays and a secondary flash, including visible wavelengths that were measured at Lauder. The black holes of this event were estimated to be about 29 and 36 times the mass of the sun, and the event took place in the region of space visible from the Southern Hemisphere, about 1.3 billion years ago. The observation confirmed a major prediction of physicist Albert Einstein’s 1915 general theory of relativity and will increase understanding of the universe.

NIWA’s Lauder Atmospheric Research Station, Central Otago.
Dave Allen

Investigating Rangiora’s air

NIWA is using new technologies to measure and analyse the movement of airborne dust and smoke particles in the north Canterbury town of Rangiora. In winter 2016 the emphasis shifted from testing technology and gauging community interest to establishing a network of indoor and outdoor sensors.

A previous trial during the winter of 2015 showed that the community wants to understand the level of airborne pollutants affecting their town, how those pollutants behave under different meteorological conditions, and how outdoor pollutant levels impact on indoor air quality. This year, sensor packages were refined to improve their reliability and sensitivity, and a network of 15 outdoor units was established across the town. These units work in tandem with compact indoor sensors installed in volunteers’ homes. The network will be further refined to give the clearest possible picture of the relationship between outdoor and indoor air quality.

NIWA’s longer-term goal is to provide regional councils and other interested parties around the country with a low-cost and proven air quality monitoring and analysis package – applicable to any town – to support planning, policymaking and implementation.

An active publicity programme has kept volunteers and the general public fully informed about the goals, methods and results. Responses to the publicity suggest there is strong interest from across New Zealand for air quality investigations of this nature.

Air quality monitoring, Rangiora.
Simon Hayes
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.

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 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.

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.

Resources

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

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.
A world first for a river

NIWA has led the creation of an internationally unique report card for the Waikato and Waipa Rivers.

It is the first time such a whole-of-catchment report has been developed which takes a holistic, rather than purely science-driven, approach, and it is underpinned by indigenous and community values. The report card is a collaboration between NIWA, Diffuse Sources Ltd and the Waikato-Raukatauri River Trust on behalf of the Waikato River Authority.

It had ongoing input from an iwi advisory group, the key information sources of the Waikato Regional Council’s extensive environmental and social databases and more than 30 subject experts from 10 organisations. The report card combines 60 indicators into scores across eight different composite indicators (called taura – or ‘strands of the rope’): water quality, water security, economy, kai, ecological integrity, experience, effort and sites of significance.

This is the first comprehensive assessment of the catchment that produces a summarised score and sets the benchmark for future improvement.

The report card gives the catchment an anticipated low rating for its wellbeing – a C+. This means that overall the standard of river catchment falls well short of the expectations of the Vision and Strategy for a healthy Waikato River.

Being able to assess catchments holistically is becoming best practice internationally, and it is anticipated the process for evaluating the Waikato and Waipa Rivers will create a benchmark and a focus for future restoration.

**Restoring and protecting the Waikato River**

**Improving the water quality of New Zealand’s longest river is no small goal.**

Waikato and Waipa River iwi and Waikato Regional Council have been using a Collaborative Stakeholder Group to develop a new plan – the Healthy Rivers: Plan for Change/Wai Ora: He Rautaki Whakapaipai. It aims to reduce inputs of nutrients (nitrogen and phosphorus), sediment and faecal bacteria into water bodies across the Waikato and Waipa River catchments, an area of 1.1 million hectares.

NIWA scientists provided information to the Collaborative Stakeholder Group on the current state and trends in water quality, the causes of water quality decline, and the remedial actions that could be put in place to improve water quality. A feature of the work was a collaborative effort with economists from the University of Waikato and Market Economics to model the effects of different options to improve water quality and compare the economic costs of those options. This technical information, and that gathered by others, was presented to the Collaborative Stakeholder Group after review by a Technical Leaders Group chaired by NIWA’s Dr Bryce Cooper and including our Chief Scientist for Freshwater and Estuaries, Dr John Quinn.

The Collaborative Stakeholder Group has now completed its deliberations and provided a proposed plan change to iwi and the Waikato Regional Council that seeks to make large-scale improvements in water quality over an 80 year time-frame, with significant steps towards that within the first 10 years.
River water quality varies widely with land use

Freshwater scientists from NIWA and Land, Water & People have released a landmark report on the quality of New Zealand’s river water, based on data gathered and analysed from hundreds of river monitoring sites around the country.

The report was published last year in the New Zealand Journal of Marine and Freshwater Research. Data were also used in the Environment Aotearoa 2015 report, compiled by the Ministry for the Environment. The study assessed the current quality of water in New Zealand rivers, and sought to identify trends in water quality from 2004 to 2013.

The monitoring sites are distributed over a range of land uses, classified as natural forest, exotic forest, pastoral or urban cover. Lowland rivers were classified separately because their water quality is an issue of continuing concern.

Water quality was assessed using eight variables: visual clarity, invertebrate communities (using the macroinvertebrate community index) and concentrations of ammonium, nitrate, dissolved reactive phosphorus, total nitrogen, total phosphorus, and the faecal indicator bacterium E. coli.

The report’s authors, led by NIWA’s Dr Scott Larned, say the picture emerging from repeated analyses of New Zealand river data is that water quality is generally compromised in catchments dominated by pastoral and urban land cover. Water quality at lowland sites is generally poorer than at upland sites, and lowland urban and pastoral sites have the lowest water quality overall.

The legacy effects of nutrients leached into groundwater, continued agricultural intensification and urban growth and projections of future intensification all highlight the ongoing need for effective management to limit future water quality degradation.

Merging mātauranga and science to benefit freshwater

Improving the way freshwater is managed by bringing together mātauranga Māori and science knowledge systems is the aim of the multi-disciplinary MBIE-funded Ngā Kete o Te Wānanga programme. NIWA is one of the three co-leaders of the programme, which is focused on enhancing our understanding of the environment and developing new approaches that recognise the positive contribution mātauranga Māori can provide for the freshwater management decision-making processes.

Two of the initial programmes are in the South Island – Murihiku (Southland) and Canterbury. The Murihiku Partnerships case study is developing a Murihiku Cultural Classification System for Water which requires mātauranga Māori, science and other knowledge systems to work together to elicit and articulate Māori cultural values and their water-related dependencies. A number of new approaches and practical tools are being developed and tested during the case study. The research is facilitated via Te Ao Marama Incorporated (a resource management agency owned by the four papatipu rūnanga in Murihiku) and is guided by the Murihiku Rūnanga Advisory Group.

The Waitaki-Opihi Partnerships case study is examining how to make scenario planning, used by regional councils to set limits for both water quality and quantity, meaningful for whānau and hapū. The study’s focus is the mahinga kai (indigenous freshwater species) trail from Tekapo to Temuka and concentrates on how freshwater management can protect wahi taonga (sites of importance to Māori) along the trail. The programme is working closely with Te Rānanga o Arowhenua, the Arowhenua Mataaitai Komiti and the Ngii Tahu Rock Art Trust.

This is a six-year programme ending in 2019, and the results will inform new approaches and tools to advance freshwater management in New Zealand.
Helping communities assess stream health

NIWA is enabling communities to undertake their own assessment of stream health.

The researchers have developed an exciting new multimedia tool which makes it much easier to identify invertebrates – key indicators of the ecological ‘health’ of waters.

The identification guide, part of the stream health monitoring assessment kit (SHMAK) developed by NIWA for volunteer use, consists of three independent but complementary components.

The first is a ‘road map’ – which guides the user through a series of yes/no questions based on body features and the way live specimens move – to their “destination” (the correct identification).

The second component incorporates real specimens embedded in resin, giving the user a 3D view and true sense of scale.

The third component, an on-line version, includes live video with 3D fly-through that adds an element appealing to citizen scientists and school students, but also allows the user to access much more detailed information and photographs than is possible with the hard-copy guides.

The three pieces of the kit all have many potential applications outside this project, both for further identification guides, and as decision-support platforms for presenting complex information.

Communities and farm groups across New Zealand have been using SHMAK to monitor stream health since 1998, and upgrades planned for 2016/17 include better assessment of visual water clarity for clean waters, a new technique for measuring faecal bacteria indicators, and a web-based database for data entry – giving community groups the ability to accurately assess ‘swimmability’.

Silverstream Restoration Group,
Lower Hutt, at the Mawaihakona Stream.
Allan Sheppard

Summer lake temperatures rising significantly

Lakes around the world are warming at more than twice the rate of oceans, and faster than the air around them.

NIWA participated in the first-ever global survey of lake temperatures, published this year, which revealed that most lake temperatures, including New Zealand’s, were rising significantly. The study, from 1985 to 2009, was by 30 key international scientists who worked to develop a unified approach to the measurement of lake water temperature trends on a global scale. The data included lake surface temperatures and vertical temperature profiles for many of the lakes.

The analysis of 236 lakes showed that most lakes warmed sharply, and the average warming of 0.34°C per decade was more than twice the 0.12°C per decade measured in the oceans over a similar period.

Rapid changes in lake temperature have profound implications for hydrology, as well as for the plants and animals living in the lakes.

The findings point to the need to update global climate models so they better predict lake warming. The study generated news stories around the world, summarising the findings and expressing the concerns of the many authors about implications for their own regions.

Lake Tarawera.
Dave Allen
Increasing whitebait habitat

Habitat loss and instream barriers are key factors in the decline of many freshwater fish species, and 76% of New Zealand’s native fish species are now classified as threatened.

To help address these concerns, NIWA has been working in a collaborative project – with the Waikato Regional Council, Hamilton City Council, Waikato River Authority, NZ Landcare Trust and the Waikato Raupatu River Trust – to build fish passes to increase Waikato’s whitebait habitat. Four such fish passes were created along Gibbons Creek in Hamilton’s Memorial Park.

The passes allow migratory fish to overcome barriers blocking their movement. NIWA scientists investigated the swimming capabilities of native freshwater fish species to help design effective solutions for overcoming migration barriers.

Work along the creek involved adding boulders and logs to protect against erosion and creating a ramp made from rocks and concrete to help the fish progress further upstream.

The aim is to enhance the native biodiversity and the number of species inhabiting the stream, particularly whitebait species such as inanga and smelt. The project is focused on helping the fish, but it has taken place in a popular recreational area so it also increases community awareness and education about the issue, which is the next step of the collaboration.

Whitebait.
R M McDowall

Leadership in freshwater monitoring

NIWA has created a new index to monitor river health using freshwater invertebrates.

It is a science-based tool that river managers can use in setting environmental river flows, which balance the need to take water from rivers for human uses and maintain sufficient flows for healthy river ecosystems.

Regional councils currently use the macroinvertebrate community index in their freshwater state of the environment monitoring programmes, but this index primarily responds to organic pollution. Invertebrate communities are also affected by river flow alterations caused by dams and water withdrawal. Hence NIWA scientists have developed the lotic invertebrate index for flow evaluation – New Zealand (LIFENZ) to assess the direct effects of flow alterations on river health.

LIFENZ takes into account water velocity and antecedent flow conditions, such as recent floods or periods of low-flow. LIFENZ is a useful tool for understanding and managing the effects of flow alterations on river ecosystems, and will help councils distinguish the ecological effects of changes in flow from effects of pollution.

Damsel fly.
Brian Smith
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 sea floor
► 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.

Resources

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

Investment

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

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.
Kingfish farming commercially viable

Close to six years of research, trials and capability-building at NIWA’s Northland Marine Research Centre culminated this year in confirmation that the kingfish breeding and supply operation is ready for commercialisation.

Performance trials have been conducted at sufficient scale to properly inform a commercial model. They confirm that NIWA has perfected the biology behind commercial-scale kingfish production, and has the infrastructure, personnel and processes in place to support that production.

Further proof has been found in the eating. The scale of production necessary for model validation has meant NIWA has had premium yellowtail kingfish available to sell, and has been supplying 200kg per week to Leigh Fisheries. This product has received rave reviews from discerning diners in top-level restaurants in Wellington and Auckland.

At one Auckland restaurant, NIWA’s farmed kingfish was served on a seafood platter that included wild kingfish. When invited to sample the product, most diners expressed a preference for the farmed kingfish, citing superior taste and texture. The restaurateur described NIWA’s product as “excellent,” with “reliable supply that is very useful when planning large-scale catered events.” He described the shelf-life of the farmed product as “amazing: almost twice what is usually expected from wild-caught kingfish.”

Consumer approval of this nature is testimony to the close control over product quality maintained in NIWA’s on-land aquaculture operation. Peak-condition fish can be supplied continuously, with quick delivery to market, ensuring the best possible eating experience for diners.

Juvenile kingfish, Bream Bay.
Alvin Setiawan
Firth of Thames mangroves are sinking, not land-building

Mangrove forests occur in the temperate estuaries of New Zealand’s upper North Island, where they have expanded rapidly over the last 50 years due to increased soil erosion and resulting estuary sedimentation.

Mangrove forests function as long-term sinks for stormwater contaminants, sequester carbon, support biodiversity and coastal food webs and, particularly in tropical areas, provide nurseries for estuarine and coastal fisheries. They can also reduce the impact of coastal erosion and inundation associated with waves, storm tides and tsunami.

Research conducted by NIWA in the southern Firth of Thames over the last few years, in collaboration with scientists from Australia, the US, the Netherlands and other New Zealand agencies, is shedding new light on an established theory that mangroves act as ‘land builders’ by causing sediment to accrete faster than it would on vegetation-free tidal flats. The study looked at the role mangroves play in estuary sedimentation and their resilience to rising sea levels.

The work, recently published, demonstrated for the first time that mangrove forests colonising tidal flats in sediment-rich environments, such as New Zealand’s estuaries, do not measurably increase sedimentation rates over the annual to decadal time scales that the forests develop. It also showed that the ability of mangrove seedlings to establish is strongly influenced by sea-level variations during the spring–neap tidal cycle, as well as by seabed disturbance by waves.

Ultimately, the survival of New Zealand’s mangrove forests depends on the surface elevation of the tidal flat keeping pace with relative sea-level rise (RSLR). The RSLR trend at any location is determined by the combined effects of increasing sea level, due to climate warming, and vertical land motion, caused by tectonic processes and/or sediment compaction. The rate of RSLR on subsiding coasts can be substantially higher than on stable coasts.

The mangrove forests of the southern Firth are subsiding at nearly 10mm per year, mainly due to sediment compaction. Although rates of vertical land motion are site-specific, the continued survival of mangrove forests in North Island estuaries will rely on sufficient sediment being supplied for tidal flat surface elevations to keep pace with RSLR.

Proposed Kermadec sanctuary

In September 2015, Prime Minister John Key announced a proposal to create a new Kermadec ocean sanctuary, stretching from Raoul Island in the north to L’Esperance Rock in the south, covering 620,000 square kilometres of ocean.

NIWA has made a significant scientific contribution to developing knowledge of the area, mainly through Tangaroa research voyages surveying the bathymetry and deepsea habitats in this largely unexplored region. A three-week collaborative Tangaroa survey of biodiversity patterns of benthic and midwater fauna planned for the Kermadec region in October–November 2016 will add substantially to our understanding.

Tangaroa’s strategic importance as a key state-of-the-art New Zealand scientific asset was reinforced in the Government’s 2016 Budget which allocated new funding of $1.5 million per year over the next four years for scientific use of the vessel, with an additional $2 million every second year for voyages to Antarctica.

Mangroves in the Firth of Thames.
Ron Ovenden
Surveying recreational fishing

Recreational fishers do not have to report their catch, but knowing how many fish are caught is vital to the sustainable management of many inshore New Zealand fisheries.

In order to provide robust estimates of recreational harvest for the Ministry for Primary Industries, NIWA and other researchers have developed and tested a suite of survey methods, including aerial surveys, concurrent boat ramp surveys and national face-to-face household surveys.

Large-scale aerial surveys are conducted every five years, and in the intervening years NIWA has developed a cost-effective method of continuously monitoring trends – using web cameras mounted at boat ramps to monitor boat traffic and by interviewing fishers returning to the ramps. The cameras record about one image each minute, around the clock. Scientists then view the images collected during a random sample of days, and count the number of boats. These traffic counts are combined with interview-based, catch-per-trip data to estimate the harvest landed annually at each surveyed ramp.

Over the past year, boat ramp surveys have been conducted in the Marlborough Sounds and Tasman and Golden Bays. The researchers selected 54 days at random to conduct the surveys at eight ramps. That was supplemented by an aerial survey at midday on the same survey days to provide a snapshot of the number of boats fishing in the area.

Significant changes in Southern Hemisphere oceans

An international team of oceanographers, including NIWA’s Dr Philip Sutton, has analysed data from ocean-profiling instruments known as Argo floats and found the Southern Hemisphere oceans between about 20°S and 40°S are warming and rising steadily, and their broad-scale anticyclonic circulations, or gyres, are intensifying.

These changes are likely to have significant long-term impacts on marine ecosystems in the region, and affect the atmospheric circulations that drive our climate.

The heat gain is at its maximum in the South Pacific Ocean at around 40°S – the latitude of New Zealand.

An initial study, led by Professor Dean Roemmich of Scripps Institution of Oceanography in the US found that the top 500m of the world’s oceans warmed at a rate of approximately 0.005°C per year between 2006 and 2014, while at depths of between 500m and 2000m the warming was approximately 0.002°C per year.

The scientists say the rates of heat gain during the eight-year period are not surprising. However, it is the first time that warming extending to 2000m and deeper, and occurring predominantly in the Southern Hemisphere south of 20°S, has been measured.

A subsequent study, published this year, confirmed that the subtropical gyre, a broad-scale anticyclonic circulation in the South Pacific Ocean, is continuing to intensify. The gyre plays a key role in transporting heat from the tropics to mid latitudes, and the intensification raises the temperature and level of the sea in the centre of the gyre.

Data for these studies came from the global network of 3750 Argo floats dotted across the world’s oceans. The floats are automated devices that descend and ascend through the top 2000m of water every 10 days, taking measurements of temperature and salinity as they ascend. They transmit their data via satellite when they reach the surface, before commencing a new measurement cycle.

Further research is planned to determine the likely long-term impacts of these findings on climate and marine ecosystems, especially in the New Zealand region. Enhanced research will be enabled by the development of new ‘Deep Argo’ floats that profile to a depth of 6000m. A pilot array of Deep Argo floats was deployed in the Southwest Pacific by RV Kaharoa in February 2016.

Daniel Jones prepares an Argo float for dispatch.
Simon Wandsworth
World-leading biological sampling text

As scientific voyages continue to uncover some of the most diverse deepsea fauna on the planet, knowledge of what exists on the seafloor is increasing rapidly.

This is happening at a time when demand for data to understand the human impacts on deepsea habitats has never been higher. However, there are inconsistencies in the way different habitats and regions have been sampled.

This issue was addressed this year by the publication of “Biological Sampling in the Deep Sea”, edited by NIWA’s highly experienced deepsea scientists Dr Malcolm Clark and Dr Ashley Rowden and Victoria University’s Dr Mireille Consalvey.

Launched in April on NIWA’s deepwater research vessel Tangaroa, the book aims to promote international consistency in sampling approaches and data collection, and advance the integration of information into global databases for improved analysis that will ultimately result into better management and conservation of the deep sea. The book is the first comprehensive compilation of effective deepsea sampling methods for a range of habitats and fills a niche in the scientific and management communities. It reviews real-life applications of current deepsea sampling tools and techniques across a range of habitats and conditions.

Toothfish not responsible for increase in Adelie penguins

The first winter fisheries survey in the Ross Sea this year uncovered new secrets about the Antarctic toothfish.

NIWA scientists on the commercial fishing vessel Janas collected embryos of Antarctic toothfish for the first time by using plankton nets to sample down to a depth of 500m. They also fertilised eggs from captured adults in spawning condition, which provides a known start time to observe developmental rates. The collaborative research survey funded by the Ministry for Primary Industries, the Commission of the Conservation of Antarctic Marine Living Resources (CCAMLR), the Institute of Marine Sciences, and fishing company Talley’s Group Limited, was to study the reproduction of Antarctic toothfish and their role in the Ross Sea ecosystem.

The discovery confirmed spawning areas and provided information about the depth the eggs drift in the water column. The information will be used to improve stock assessment and ecosystem models and advance management of the fishery.

Meanwhile, NIWA scientists also contributed to new understanding about the diets of Adelie penguins in the Ross Sea. Over the past decade the number of breeding pairs of Adelie penguins has more than doubled, something attributed to better availability of silverfish – a prey species of toothfish and penguins. It was assumed that a decline in the number of Antarctic toothfish had resulted in an increase in silverfish available to the penguins. However, NIWA data show that silverfish are not the main prey species for toothfish in the southern Ross Sea and their population decline is not responsible for the increases in the number of Adelie penguins.

An estimated 102kg Antarctic toothfish from the Ross Sea.

Dawie Potgieter
Planning for the future of our marine resources

Deciding how to use, and at the same time conserve, ocean resources is complex.

However, balancing resource exploitation, biodiversity conservation and other uses and values in oceans around the world is being made easier with the use of trade-off models such as Zonation and Marxan.

These tools can combine all the uses and values of the area in question, as well as habitat and biodiversity features and ecosystem service layers. The models then take into account ecological, social, economic, and governance aims to evaluate trade-offs and determine management options that provide maximum benefits. Uses include informing biodiversity conservation and management, such as identifying the best places to set aside for areas closed for fishing, because the models provide the most effective outcome in terms of biodiversity, while minimising the effects on existing users.

NIWA’s expertise in this area is used to support marine spatial management in New Zealand and internationally. Recent projects include spatial planning processes (e.g., Sea Change, the Hauraki Gulf Marine Spatial Plan), resource consent applications (e.g., Chatham Rock Phosphate), and other spatial assessments (e.g., the Ross Sea MPA proposal by New Zealand and the US to the Convention for the Conservation of Antarctic Marine Living Resources and the South Pacific Regional Fisheries Management Organisation analysis of threatened taxa for the New Zealand Government). The need for skill and knowledge in the use of these tools is likely to increase as the conflicting demands on our marine resources increase.

Snapper on the line.

Chris Sisarich
**Remarkable swimming feats revealed**

The remarkable long distance swimming abilities of two penguin species were revealed by a NIWA scientist for the first time earlier this year.

Dr David Thompson, a seabird ecologist, identified that sub-Antarctic rockhopper penguins and Snares crested penguins can travel more than 15,000km while at sea between April and October.

Although the Snares penguin population is relatively stable, rockhoppers at Campbell Island have declined by at least 21% since 1984, leaving just over 33,000 breeding pairs on the island – once the world’s largest breeding colony for these birds.

The scientists tagged about 90 penguins, modifying electronic monitors used on albatrosses to fit the stubby penguin legs. The tags were retrieved when the birds returned to land for breeding. The Snares penguins headed exclusively west towards Australia, whereas the rockhoppers went east and covered a wider section of the ocean. Several birds covered more than 15,000km over the winter. The tags were also able to determine when the penguins were stationary, indicating they had stopped to dive for food or rest.

More tagging is planned to include other penguin species to provide more information on how they relate to each other and to better understand whether particular parts of the ocean help them survive from one year to the next.

**Southern right whales secrets uncovered**

Since the decimation of the southern right whale population in New Zealand by whaling in the 1800s, research on its recovery has focused on the wintering ground at the Auckland Islands.

However, in 2014, for the first time in 20 years, NIWA in conjunction with the Department of Conservation, went to Campbell Island in the sub-Antarctic to document and describe southern right whales occupying this wintering habitat. In March this year, a paper on the findings of the expedition was published in the scientific journal *Polar Biology*. The aims of the expedition were to find out whether the southern right whales still spent winter at Campbell Island, how many there were, where they came from and what they ate.

The scientists confirmed a large contingent of the whales by using a variety of methods – including photo-identification, genetic and stable isotope analyses of tissue samples, and visual surveys of abundance and distribution – to provide details on the demography, population connectivity and ecology of southern right whales wintering at Campbell Island.

The main findings included matching nine whales observed at Campbell Island previously documented elsewhere in New Zealand and increased abundance estimates over the last 20 years.

There were also indications the southern right whales forage within the sub-Antarctic region. The results confirmed that the Auckland Islands are currently the only significant calving area for southern right whales in New Zealand, and therefore previous abundance estimates based on demographic data from the Auckland Islands are applicable to the entire New Zealand population.

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**Penguin winter movements revealed.**

The scientists believed winter was particularly important to penguins and there was something happening in the ocean causing population decline.

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**Southern right whale.**

*University of Auckland*
Science staff and crew of Tangaroa in the Ross Sea.

Dave Allen
Our reputation for outstanding research and applied-science services has its foundation in an inspired and skilful workforce resourced with leading-edge equipment. Our people collaborate nationally and internationally, forming the best teams to advance science and deliver global and national benefits.

Leadership, culture and engagement

The annual NIWA Leaders’ Forum brings together all staff with management responsibilities to update them on organisational performance and key objectives for the coming year.

The Forum facilitates engagement and discussion on operational strategies and provides opportunities for networking with fellow leaders and external stakeholders. The theme this year was Talking Science – effective communication – focusing on how we can make our science more accessible and maximise engagement with our stakeholders.

There was continued improvement in our biennial staff survey results this year, building on the already good 2014 results across all sections. Confidence in the leadership of the organisation, encouraging ideas and suggestions from employees, the quality of products and services being a top priority, the availability of career development opportunities, NIWA caring about staff wellbeing and communication being open and honest were the big movers from already pleasing levels.

As part of our ongoing efforts to increase engagement with tertiary students, we trialled a summer internship programme during the 2015/16 university break.

Interns received personalised inductions, work experience in a specific science area, a career planning session with the General Manager, Operations and exposure to other science areas. The internships were very successful, delivering value for both NIWA and participating students, and will now be offered annually when practicable.

NIWA has a longstanding relationship with the Sir Peter Blake Trust, and this year offered five Blake NIWA Science Ambassador opportunities. As well as getting hands-on experience, the Ambassadors benefit from developing relationships and partnerships in their field of science. This year activities included a fisheries, biodiversity and seabed geology voyage on Tangaroa on the Chatham Rise, climate and atmospheric studies at Lauder and Wellington, and freshwater quality field measurements and surveys of waterways, rivers and lakes in Hamilton and Christchurch.

The Blake NIWA Ambassador programme advances the Trust’s mission to inspire and mobilise the next generation of Kiwi leaders, adventurers, and environmentalists. The Ambassadors contribute to NIWA’s science and become passionate promoters of the role of science in society. They also become potential recruits for the science community. The strength of our relationship with the Trust, and the alignment of our aspirations, is evolving into NIWA becoming the Trust’s official Science Partner to further advance our mutual objectives.
NIWA is an equal opportunities employer, and all NIWA policies and practices are based on the principles of fairness, equity and non-discrimination. We value diversity and proactively engage with employees and their representatives about improvements to workplace programmes and practices.

We have a high-performance, high-trust culture, and our flexible working practices help staff balance work and non-work commitments. Twelve percent of our staff work part time.

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

Retention remains high
NIWA has an excellent employment brand which enables us to attract applicants of the highest calibre. Our managers receive training in recruitment and selection best practice to facilitate thorough and objective recruitment processes. This year we welcomed 52 new staff to NIWA.

An induction programme is tailored for each new employee to ensure they receive job-specific information, along with more general operational information that will enable them to operate efficiently. We monitor induction quality and relevance through a post-induction interview.

Staff development a key focus
Our performance and development framework facilitates high-quality conversations between staff and their managers and the creation of measurable objectives. Staff and managers meet at least twice a year for structured performance and development discussions, and regular informal communication takes place throughout the year.

Our retention rate has remained high over the year at over 93%. The stability of our high-performing workforce continues to be a key strength.
This year, nine of our senior leaders participated in a seven-day pan-CRI leadership mindset programme over the course of five months.

The annual workforce planning process covers workforce resourcing and development strategies and detailed action plans for National Science Centres, regional management and support functions. Our ongoing focus on aligning capability and capacity with anticipated market demands ensures we are well placed to meet the current and future needs of our customers.

Every year, a rigorous level review process is undertaken to recognise staff who have significantly increased their skill base and are making a greater contribution to our research and applied science. This year there were 18 level promotions.

NIWA takes a holistic approach to development. In addition to providing extensive professional development support, this year we funded 669 personal development days, in which staff pursue training or a related activity of their choice.

Our staff are encouraged to attend and actively contribute to national and international conferences. Such engagement greatly facilitates the development of professional networks, advances research and helps tailor science and services. This year our staff attended more than 295 conferences.

NIWA’s climate specialists work to mitigate risk from floods – Andrew Tait, Suzanne Rosier, chief scientist Sam Dean, Kate Crowley, Ryan Paulik (L-R).

Dave Allen
Rewarding and recognising our people

NIWA has well-established reward and recognition processes to ensure our people receive appropriate remuneration, considering both internal and external relativities.

In addition to our annual merit-based salary adjustments, we also review proficiency to recognise the development of knowledge and skills, and 58 staff this year received remuneration increases as a result.

A new Individual Employment Agreement (IEA) was developed for non-union staff members. We engaged extensively with relevant staff, and the resulting agreement reflects contemporary terms and conditions which will increase our agility, while we continue to offer remuneration and benefits in line with market benchmarks. The new IEA was very positively received, with more than 85% of eligible staff choosing the new terms and conditions.

NIWA’s exceptional talent was showcased at the fourth annual NIWA Excellence Awards ceremony. Held in conjunction with the annual NIWA Leaders’ Forum in October 2015, the ceremony celebrated the achievements of 10 winners, 10 runners-up and a Lifetime Achievement Award winner. Given the high-performance culture which exists across the organisation, these are prestigious awards recognising very significant achievements.

We also celebrate the proficiency of our many photographers at the award ceremony. Our staff work in some of the world’s most stunning environments and many are excellent photographers. Their photographs help us connect with the public and our many customers and stakeholders as we popularise our science and demonstrate the value it creates.

The outstanding success this year was the NZ Marine Sciences Society Award presented to Rob Murdoch, General Manager, Research – the latest in a long line of NIWA staff to have been recognised this way.

2015 NIWA Leaders’ Forum held in Auckland in October.

Dave Allen
A safe and healthy environment

NIWA Safe is our safety pathway, guiding our journey towards zero harm by continually improving how we operate. The three key focus areas of NIWA Safe are safety leadership, safety systems and safety behaviour.

Six critical risk teams manage particular safety risks inherent in NIWA’s scope of activity, and the safety leadership team provides organisational oversight and direction. Preventative and curative care programmes support our occupational health and wellbeing emphasis.

We actively promote a safe and positive working environment. Our unacceptable behaviour policy includes zero tolerance for bullying and harassment. Guidelines for professional behaviour convey clear expectations of how we behave, communicate and interact at work. External counselling support, which is free and confidential, is available for any staff member who is experiencing difficulties.

The new Health & Safety at Work Act 2015 includes an increased responsibility for all agencies involved in an activity to ensure the safety of all workers. For NIWA, this includes work we do for clients, work that suppliers or subcontractors do for us, and our activities with community-based groups. Our clients will be seeking greater safety assurance from us, and we will have the same expectations of our suppliers, subcontractors and others.

Launching an ozonesonde at the Lauder Atmospheric Research Station.
Dave Allen

Sir Christopher Mace, KNZM – for services to science and education

NIWA Chairman since 2009, Chris Mace received a knighthood in the Queen’s Birthday Honours List 2016 for services to science and education.

Chris has a long association with New Zealand science, chairing the Institute of Environmental Science and Research in the 1990s and later Antarctica New Zealand. He continues to serve on the Antarctic Heritage Trust Board, having joined in 2003, and has a mountain named after him, Mount Mace, in recognition of his services to Antarctica.

He chaired the University of Auckland’s South Pacific Marine Science Advisory Board from 2006 to 2012, helping guide the development of the Leigh Marine Research Centre.

Chris was Chairman of the Board of a joint effort between the universities of Auckland, Wellington and Otago to establish a national platform for advanced teaching and postgraduate research in marine sciences. He is currently a Commissioner of the Tertiary Education Committee.

Chris, with his wife Dayle, is a keen supporter of the arts through the Auckland Art Gallery, Auckland Theatre Company, the Venice Biennale, the Arts Foundation and the Auckland Writers Festival.

In 2004, Chris was made a Companion of the New Zealand Order of Merit for services to Antarctica and the community. He was Māori Business Leader of the Year in 2011, and in 2015 was inducted into the Business Hall of Fame.

Sir Christopher Mace.
Dave Allen
All figures are for NIWA Group as at June 30 2016

**Personal development**
3 days a year provided for each employee for personal development. A total of 5021 personal development hours (669 personal development leave days).

**PSA membership**
357 members

**Recruitment**
21 new permanent positions
21 permanent replacements

**Number of staff attended national or international conferences funded by NIWA during the year:**
International – 95
National – approx. 200

**Disabilities**
Total number of people with disabilities = 9 (1%).

**Staff Turnover**
NIWA Group – 6.28%

**Remuneration Reviews**
(in addition to standard process)

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<td><strong>Total</strong></td>
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Communicating Our Science

Over the year we featured in mainstream media more than 4000 times, issued 120 media releases, reached a total audience of 70 million people and, most significantly, the equivalent cost of advertising to achieve that amount of publicity was $9.7 million, an increase of $1.2 million on last year.

Our social media following and engagement continues to climb. Our Facebook, Twitter, Google+, LinkedIn and Instagram channels now have a combined following of more than 20,000 people.

Our content on social media received more than 1.4 million viewings over the year. Our corporate website (niwa.co.nz) had more than 2 million pageviews over the same period.

We continue to strengthen our engagement with the science community by directly sponsoring 15 conferences throughout the year, and by our people attending and actively contributing to many more.

We are also the lead sponsor of six major regional science and technology fairs and secondary sponsors of another eight. Thousands of children, their families and the community at large are involved in these highly successful events which encourage the use of science to provide the answers to some aspect of their lives and promoting the value of science to a wide audience.

Despite appearances, all safety precautions were taken: atmospheric technician Zoe Buxton in the media eye at Baring Head.

Dave Allen

<table>
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<tr>
<th>Total Science Outputs</th>
<th>Commissioned Client Reports</th>
<th>Total Conference Presentations</th>
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<tr>
<td>1660</td>
<td>340</td>
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Including:
- 4 keynote presentations
- 244 overseas conference presentations
- 62 conference poster presentations and participation in Commission for the Conservation of Antarctic Marine Living Resources

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<th>Published/Submitted Articles and Books or Book Chapters</th>
<th>Other Reports</th>
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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.
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.

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.
NIWA 2016 EXCELLENCE AWARDS

Our annual NIWA Excellence Awards – announced during the NIWA Leaders’ Forum each year – 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.
NIWA EXCELLENCE AWARDS WINNERS

Wendy Nelson
Research Excellence
Wendy is New Zealand’s foremost macroalgal phycologist and is recognised globally for the excellence of her work, involving systematics, phylogeny, biogeography, ecology and life-Histories. Her research on the important red-algal order Bangiales, which includes the sushi seaweeds, revolutionised global understanding of this group. Her many research papers, awards and national and international appointments testify to her excellence, and her landmark “New Zealand Seaweeds” is a seminal illustrated guide.

Neil Bagley
Leadership
Neil demonstrated outstanding leadership during NIWA’s first fisheries assessment in the United Arab Emirates. In the face of many hurdles, it was completed to a high standard, on time and to budget. It was a politically, culturally, and logistically challenging programme requiring diplomacy, good communication with clients and contractors, and the ability to maintain motivated and efficient teams amidst daily challenges. Neil’s significant personal commitment to the delivery of the survey was greatly appreciated by his colleagues, collaborators and clients.

Graham McBride
Applied Science Excellence
Graham has a national and international reputation in environmental science and is an authority on issues of water quality, water pollution and health-related microbiology. He was instrumental in establishing monitoring principles and design criteria for the National River Water Quality Network. Graham’s application of statistical techniques to environmental issues has helped the formulation, implementation and interpretation of more effective methods for water quality management, and his study on freshwater microbiological indicators and pathogens led to the revision of national guidelines.

Phil Jellyman
Early Career Science
Phil has an impressive publication record of 19 scientific papers since completing his PhD in 2011. He has also published three book chapters, given 18 presentations at national and international conferences, lectured MSc students and supervised three PhD and six BSc (Hons) students. His research includes highlighting the importance of biotic interactions when making water allocation decisions, which will help shape freshwater management.

Susan Pepperell
Support Services
Susan is primarily responsible for NIWA’s outstanding media profile. Her drive, judgement and connections consistently deliver results well beyond expectations. She is the first contact point for all media enquiries and is highly-respected throughout the industry. She works closely with scientists to help communicate their work to our external audiences, raise the constituency of science in society and reinforce NIWA’s reputation as the authority.
Tracey Burton
Science Communication

Tracey has long been the driving force behind NIWA’s sponsorship and engagement with the nationwide school Science and Technology Fairs. These very high profile events give students the opportunity to demonstrate how science informs society and provides solutions, and NIWA is the naming rights sponsor of six main city fairs and an award sponsor of another eight. Tracey is our key contact, working with the organisers, science teachers and their pupils directly to foster an interest in science.

Dylan Baars
Operational Innovation

Dylan’s innovation with a world-leading, remote-logging telemetry system has led to major efficiencies in the study of freshwater fish ecology. He developed a data-capture system to use with small passive integrated transponder (PIT) tags, which is superior to anything previously available and placed NIWA at the forefront of PIT technology and use. It has eliminated data loss, and the remote control can substantially reduce costs as well as save irreplaceable information.

Neale Hudson
Project Delivery

Neale took on a complex and challenging Government-funded project involving many contributors from multiple Crown Research Institutes. His leadership and careful management ensured the project was delivered on time and on budget, meeting the client’s expectations and strengthening NIWA’s reputation and relationship with the client.

Jim Drury
Health & Safety

Jim’s name is synonymous with boating safety excellence in NIWA and the associated maritime industry. He is an outstanding leader of safety culture and safe boating practice. For more than a decade his efforts have enabled NIWA to safely manage more than 25 powered vessels, and maintain training and certification for more than 50 skippers. His efforts this year led to NIWA successfully attaining a ‘Maritime Transport Operator Certificate’ on first application under extensive and stringent requirements.

Helen Neil
Customer Focus

Helen has exceptional customer focus. She has been the lead author or project director on multiple major projects and her opinions and advice are sought by both commercial customers and government agencies. Clients appreciate her knowledge, regular contact, agility and ability to deliver. They also appreciate her sensitivity, strategic advice and ability to tailor science and services which demonstrate the value of NIWA’s research and best address customers’ needs.
Roger Goodison
Master, RV Tangaroa

Roger is retiring in December 2016 after a 35-year career with MAF Fisheries and NIWA. He joined MAF Fisheries Research Division as 1st Mate, RV James Cook in 1981, was appointed Master in 1987, and Master of the purpose-built RV Tangaroa in 1991.

Roger attended the building of Tangaroa in Norway and was part of the delivery team that sailed the vessel to New Zealand in 1991.

His long and varied career has given him an excellent understanding of the intricacies of undertaking marine research in New Zealand waters, and he consistently achieves voyage objectives with enthusiasm, optimism and professionalism, ensuring the safety of vessel, crew and science staff.

Roger has been on almost 200 research voyages, at least 150 of those as Master and is justifiably proud of both the vessels’ achievements and of NIWA as a premier science organisation. He has been one of the key individuals instrumental in maintaining our excellent reputation with our scientists and those from other institutions and nations.

Ken Grange

Ken published his first research paper as a university student, and that was followed by invitations to join research expeditions to the Southern Oceans, the Cook Islands, the Bahamas, Florida, and the Galapagos Islands. These were interspersed with major new research on the invertebrate communities of Manukau Harbour and the biology and ecology of Fiordland’s black corals.

He has carried out extensive research on coastal ecosystems and the impacts of fishing on the marine environment, pioneered work with iwi on taipure and mahinga matalai, and led the development of the science evaluating the ecological effects of aquaculture.

Ken has published more than 50 scientific papers, 10 book chapters, 300 client reports and popular articles, and delivered more than 40 briefs of evidence to the Environment Court and related hearings.

He contributes to many advisory groups, is a former president of the NZ Marine Sciences Society and for the last 12 years has managed the NIWA Nelson office. Ken is a true statesman of marine ecology and environmental science.
NIWA 2016 PHOTOGRAPHY AWARDS

Every year NIWA staff carry out their work by getting away from it all – they travel to some of the most remote, and beautiful, places on the planet. It has to be said, however, that many of those just happen to be in New Zealand.

This year, entries for the annual NIWA photography competition spanned the globe from the Arctic to the Antarctic, from way up in the atmosphere to deep in the ocean, proving that NIWA staff really do go to the ends of the earth to get the job done.

The judges, Gerry le Roux from Science Lens, Ross Giblin of Fairfax Media, and NIWA’s graphic designer Mark Tucker, looked at 350 entries in several categories and were extremely complimentary.

“Some very strong images yet again – there certainly are some talented photographers on staff. It was a great spread of photos; some real stand-outs and the final choices were very close,” they said.

And now the competition is over for another year, many of the photographs will feature on the NIWA website, in the NIWA calendar, our magazine Water & Atmosphere and a wide range of media outlets.

Our Places

Rob Murdoch

Stormy evening over Lake Rotorua

The judges called this photograph a “classic calendar shot” that was very well executed.

“It is a beautiful, calming photo with an effective colour palette and composition. It has good leading lines, sharpness, and nice subdued yet saturated colours.”

Overall the photo was well composed with well captured light that resulted in a sensitively tranquil shot.

Our Work (previous page)

Rob Murdoch

Southern Buller’s albatross giving the evil eye

NIWA’s General Manager, Research, Dr Rob Murdoch, is well known for his ability to take beautiful close-ups of birds. And this image certainly had the wow factor the judges were looking for.

“What a striking, powerful bird portrait of a mollymawk that looks like it has had make-up applied. Lovely symmetry, lines, sharpness and colour saturation,” they said.

“A superb, dramatic shot, in sharp focus allowing all the detail to emerge, just brilliant.”
Our People

Alison Kohout
Arctic Sunset
Hydrodynamics scientist Dr Alison Kohout had just finished a day’s work measuring the growth and decay of sea ice in the Arctic when she took this shot during one of the Arctic’s typical long autumn sunsets. The judges were impressed with her photo that they said showed contrasting moods, cold shadowy snow and a warm sunset glow with a hulking ship dwarfing the people.

“There is a nice leading line between the people and the boat, connecting the different parts of the composition. The vastness of the scene is well captured.”

People’s Choice

Ayushi Kachhara
Milky Way in The Remarkables
A work trip to Queenstown combined with a passion for astronomy prompted Auckland-based air quality scientist Ayushi Kachhara to enter this photo taken from a lookout on the way to The Remarkables. But what is remarkable is that clear skies that really attracted her, something that doesn’t happen a lot more in light-polluted Auckland.

The People’s Choice award is voted for via social media and this shot was a clear winner, gaining more than three times the number of votes than her nearest rival.

Special Award

Crispin Middleton
Underwater Angel
Specialist diver Crispin Middleton has been trying to get pictures of flying fish for years but as soon as they got he got near them they’d simply fly away. This year he finally managed to master getting a very rare photograph of a juvenile flying fish in water.

The judges loved the shot.

“This flying fish looks like a piece of jewellery set against a dramatic black background,” they said.

“It has beautiful colour and is a very detailed image. An iridescent jewel against the dark of the ocean, beautifully captured and nicely lit to show all its subtle colour. This would have been a rare shot to capture.”
Shannan Crow
*Blue glacial headwater, Rakaia River*

A Canterbury stream captivated freshwater fish ecologist Shannan Crow - and the judges.

They commented that the photo was beautifully composed, allowing the water to really come alive with the use of a slow shutter speed and light.

“We love the subtle colours. It is a well-framed, balanced shot. The eye is drawn from the soft light on the rock, further up the river to the glow of the mountains.”
Nick Main
Deputy Chairman

Nick is a chartered accountant and was CEO 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.

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.

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.

John Morgan
Chief Executive

John joined NIWA as CEO 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, CEO 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.
Sir Christopher Mace
Chairman
Sir Christopher 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 CEO 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

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

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 served in senior country finance management positions in Europe and the Middle East before joining Ford New Zealand in 2004. After choosing to settle permanently in New Zealand in 2012, he was appointed CFO of The Network for Learning Limited, a Crown company established to deliver managed internet services to New Zealand’s schools. He joined NIWA as CFO and Company Secretary in May 2014.

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 2015. Andrew brings to the role skills as a software architect, developer and specialist in human computer interaction. This reflects the 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. Andrew’s goal for the group is to become more agile and responsive while still maintaining the bedrock of IT infrastructure, data management and resilient service delivery.

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 2001, she practised as a consultant psychologist for 15 years, both in private practice and for several large consulting firms. Prior to that she worked in evaluation research with a range of community, justice, public health and health promotion programmes. Mary-Anne has extensive experience in psychological assessment, learning and development, executive coaching, leadership development, and organisational change and performance improvement initiatives.
Geoff Baird
General Manager, Communications & 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 in the assessment of the effects of changes in land use and floods on river ecosystems, particularly on algae and plant growth. 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.

Dr Rob Murdoch
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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 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.

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Flying fish
Crispin Middleton
Dr Sam Dean  
Chief Scientist, Climate and Atmosphere, Natural Hazards  
PhD (Physics), University of Canterbury

Sam began his research career with a postdoc at the University of Oxford before joining NIWA in 2006. He is an expert on using climate models to understand the drivers of climate variability in New Zealand and Antarctica, and in particular human-induced climate change. His research has identified the contribution of human-induced warming to intensifying current New Zealand weather extremes. Recently he has been part of a team investigating the interactions between Antarctic sea-ice, atmospheric circulation and the Southern Ocean.

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 as NIWA’s Chief Scientist, Aquaculture, 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 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 John Quinn  
Chief Scientist Freshwater and Estuaries  
PhD (Massey)

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 2015.

Dr Jochen Schmidt  
Chief Scientist, Environmental Information  
PhD (Geography), University of Bonn

Jochen has a background in hydrology, geomorphology, soil science, geoinformatics, 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 Chief Science Advisor

Clive is an aquatic ecologist with more than 35 years of 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 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. He also oversees NIWA’s maritime fleet.

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; PGDipSSER (Massey University)

Alan has a science background in ecology and earth sciences. He has extensive experience in research administration and science and technology programme evaluation. 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 environmental research in many settings, including rivers, temperate and tropical rainforests, coral reefs, estuaries, lakes and aquifers. He specialises in nutrient dynamics and algal ecology. At NIWA, Scott has led projects and programmes in water quality, environmental flows, invertebrate and periphyton ecology, and surface water-groundwater science. He has been a NIWA principal scientist since 2008 and is also a Programme Leader in the Our Land and Water National Science Challenge.

Douglas Ramsay
Manager, Pacific Rim
BEng (Civil Engineering), University of Aberdeen, MSc (Water Engineering), University of Strathclyde; MRA, 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 leads NIWA’s endeavours to maximise the transfer of natural resources and environmental science knowledge to Māori entities and communities, leading Te Kawaha and working closely with other NIWA staff. He joined NIWA in 2015 from Landcare Research, where he was the Māori Partnerships Manager – Business Development. His tribal affiliations are Ngāi Tūhoe, and he comes from Ruatahuna, in Te Urewera.
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 within the Coasts and Oceans Science Centre. Alison led a marine ecology research group before joining the Operations Management Team in 2015 where her focus is on staff, project, and operations management, with particular responsibility for health and safety.

Dr Helen Rouse  
Regional Manager, Christchurch  
PhD (Physical Geography), University of Hull

In her 20 years in New Zealand, Helen trained as a coastal geomorphologist with a PhD from the University of Hull, UK and in that time has worked as a Teaching & Research Fellow at Lincoln University, as Environmental Information Manager at the West Coast Regional Council, and as a National Advisor for the Tertiary Education Commission. She joined NIWA in 2007, first as a resource management scientist then from 2014-15 as National Projects Manager, and has been Regional Manager of the Christchurch region since January 2016.

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 37 years’ experience in science research and operational management. He has conducted research at the New Zealand Meteorological Service, in the UK, and at NIWA, and led a research group in NIWA before becoming a full-time regional manager in 2000 and then Senior Regional Manager in 2008. His focus for the last 16 years has been on staff and operations management. He has also represented New Zealand in intergovernmental forums.

Charles Pearson  
National Manager, Environmental Information Operations  
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 has extensive staff and operations management experience becoming full-time Regional Manager to Christchurch in 2006, and was appointed to the new position of National Manager, Environmental Information Operations in January 2016.

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 working for NIWA and within the power industry. His specialist areas have been marine and freshwater ecology, ecotoxicology, environmental impact assessment and resource management. David has been Regional Manager in Hamilton since 2002.

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.

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, storm water management and water resource allocation.
Dr Julie Hall
Regional Manager, Wellington
PhD (Aquatic Toxicology),
University of Manitoba

Julie is a marine and freshwater biologist who has spent 20 years working for DSIR and then NIWA, specialising in phytoplankton, microbial food web and zooplankton studies in both marine and freshwater. She joined the Operations Management Team in Wellington in 2008 where her focus has been on staff, project and operations management. In 2015 Julie was appointed as Director of the Sustainable Seas National Science Challenge and now divides her time between this position and her position as Regional Manager in Wellington.

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, having worked on diverse projects from sub-Arctic Canada to New Zealand’s subantarctic and Antarctica. Graham continues active work on groundwater biodiversity and ecology in New Zealand, presenting science aimed at enhancing the sustainable use of these very important ecosystems. He joined NIWA in 2002 and brought his blend of science, business and academic experience to the Operations Management Team in 2008.

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NIWA STAFF

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FULL-TIME EQUIVALENT STAFF

16
NIWA SITES
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.

Kaharoa moored in Wellington during the Lux light festival.
Allister Taylor
<table>
<thead>
<tr>
<th>National Centre for Climate and Atmosphere</th>
<th>National Natural Hazards Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding the complex relationship between atmospheric composition and how our climate behaves, and is changing, 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.</td>
<td>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.</td>
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<tr>
<td><strong>Our work includes:</strong></td>
<td><strong>Our work includes:</strong></td>
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<tr>
<td>▶ quantifying the exchanges of greenhouse gases between atmosphere, ocean and biosphere</td>
<td>▶ determining the frequency and magnitude of natural hazards</td>
</tr>
<tr>
<td>▶ quantifying the relationship between atmospheric composition and climate</td>
<td>▶ estimating risk</td>
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<tr>
<td>▶ measuring agricultural greenhouse gas emissions</td>
<td>▶ forecasting hazards by using integrated tools and modelling</td>
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<td></td>
<td>▶ assembling research outcomes into meaningful and helpful outputs for end users.</td>
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<td></td>
<td>niwa.co.nz/our-science/natural-hazards</td>
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<tr>
<td>National Aquaculture Centre</td>
<td>National Centre for Coasts and Oceans</td>
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<tr>
<td>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.</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Our work includes:</strong></td>
<td><strong>Our work includes:</strong></td>
</tr>
<tr>
<td>▶ developing high-performance aquaculture</td>
<td>▶ oceanography, ocean geology, marine ecology, primary production and microbial processes</td>
</tr>
<tr>
<td>▶ assessing and modelling the environmental effects of marine farm operations</td>
<td>▶ undertaking environmental impact assessments</td>
</tr>
<tr>
<td>▶ providing advice on designing and managing marine farms, and providing associated training</td>
<td>▶ determining rates of coastal erosion, and climate change impacts on the coast</td>
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<tr>
<td>▶ conducting research into fish health</td>
<td>▶ investigating impacts of coastal outfall and discharges</td>
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<tr>
<td>▶ providing breeding services</td>
<td>▶ habitat mapping and swath bathymetry of coastal environments.</td>
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<tr>
<td>▶ conducting feed trials.</td>
<td>niwa.co.nz/our-science/coasts</td>
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<tr>
<td>niwa.co.nz/our-science/aquaculture</td>
<td>niwa.co.nz/our-science/coasts</td>
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<tr>
<td>National Centre for Environmental Information</td>
<td>National Centre for Coasts and Oceans</td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td><strong>Our work includes:</strong></td>
<td><strong>Our work includes:</strong></td>
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<tr>
<td>▶ monitoring the environment through our national observation services and networks</td>
<td>▶ acquiring, storing and disseminating metadata – information about how, where, when and by whom environmental information has been collected.</td>
</tr>
<tr>
<td>▶ managing the information we acquire</td>
<td>niwa.co.nz/our-science/ei</td>
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<tr>
<td>▶ delivering information in user-focused ways</td>
<td></td>
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<tr>
<td></td>
<td>▶ investigating impacts of coastal outfall and discharges</td>
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<td></td>
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<td></td>
<td>niwa.co.nz/our-science/coasts</td>
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</tbody>
</table>
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

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-kowaha

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
Technology and tools to support sustainable irrigation

Approximately 750,000ha of New Zealand’s farmland is irrigated, according to latest Statistics New Zealand figures. This total continues to grow, as new tracts of land in drier eastern regions of the country are brought into production or converted from dry-land farming.

Recent analysis by Irrigation New Zealand and the New Zealand Institute of Economic Research suggests that irrigated farmland is typically three times as productive as equivalent areas of land farmed using dry-land systems. In 2012, irrigation contributed an estimated net farm-gate GDP of some $2.17 billion.

Irrigation is driving growth in the New Zealand farming sector, but also raising critical questions about sustainability. Long-term stress on water supplies, and nutrient leaching into waterways caused by ill-timed or unnecessary irrigations, are challenges running hand-in-hand with the sector’s expansion into low-rainfall regions.

NIWA is leading several initiatives to help individual irrigators and irrigation scheme managers achieve sustainable growth.

NIWA’s goal is to ensure farmers irrigate only when needed. The decision not to irrigate is as much in the long-term economic and environmental interests of the country as the decision to irrigate.

NIWA is providing the science and developing partnerships and tools that give farmers simple guidance on when and when not to irrigate – enabling them to maximise productivity and minimise the risk of wasting water and leaching nutrients.

During the year, NIWA installed an additional ten ‘ImiMate’ soil moisture and weather monitoring stations on farms around the country. These stations provide data that directly drive irrigation decision-making at farm and scheme scale. A number of ImiMate stations are installed on farms served by large-scale irrigation schemes such as the Waimakariri Irrigation Scheme in Canterbury. The data they provide ensure participating farmers gain maximum economic benefit from irrigation water supplies that are tightly controlled.

NIWA also continued to develop its ‘ImiMet’ online tool, which will give subscribers at-a-glance ‘do or don’t’ irrigation guidance for up to six days ahead. ImiMet will draw data from the nearest climate monitoring station and use NIWA’s sophisticated high-resolution weather forecasting capabilities to predict irrigation need based on maintaining an optimum level of moisture in the root zone of the soil. It will enable farmers to experiment with different irrigation amounts to achieve the desired soil moisture balance, and it will estimate economic losses resulting from poor irrigation decisions.

ImiMet will launch in October 2016.

As a next step, NIWA will integrate its ImiMate and ImiMet technologies to offer farmers a complete and accurate decision-support package – utilising soil moisture and weather data drawn directly from the farm paddock to drive ImiMet’s scheduling algorithms.

Dave Allen
The science behind sustainable fisheries

New Zealand’s world-leading Quota Management System for fisheries in our vast Exclusive Economic Zone marks its 30th anniversary this year.

The anniversary is being widely celebrated by the fishing industry, and NIWA’s role in the success of the QMS is being acknowledged in a series of articles in Seafood New Zealand, the bimonthly flagship industry magazine.

Seafood NZ and NIWA this year collaborated to promote better understanding about the QMS. The science behind the system was the subject of the cover story for the April edition of the magazine. The article highlighted how NIWA scientists use statistical modelling for analysing the data from catch records submitted by fishing vessels and Ministry for Primary Industries observers.

This work contributes to one of the most crucial components of ensuring effective fisheries management – the need for accurate reporting of the amount of fish and invertebrates caught and discarded by the industry, which earns about $1.6 billion in export earnings annually.

Subsequent articles focused on how NIWA monitors trends in fisheries abundance and on how we determine current status of the stocks and what levels of future catch might be sustainable.

NIWA has a 25-year history of bottom trawl surveys for key offshore hoki and other middle-depth fisheries and South Island inshore fisheries. This enables tracking of the number of fish recruited to a fishery and also the young pre-recruits that will be available in a few years.

Deepwater acoustic technology developed by NIWA to enable surveys down to more than 1000m deep was also highlighted, along with our state-of-the-art analytical software for stock assessment.

Seafood NZ has also acknowledged that the accuracy of the science behind the QMS reveals New Zealand’s fisheries are performing extremely well, with about 83% of individual fish stocks above the level where sustainability would become a concern.

A model of success for Bluff oysters

Stock assessment modelling is reliably predicting trends in the Foveaux Strait oyster population and helping the fishery deal with the effects of high disease mortality caused by the parasite bonamia.

Bonamia is thought to be an endemic parasite and was first identified in Bluff oysters in the early 1960s. A single-cell disease that affects the blood cells of oysters, bonamia is unlikely to disappear from the fishery and is expected to be a recurring problem.

In partnership with the Bluff Oyster Management Company (BOMC), NIWA undertakes annual oyster population and bonamia surveys. These surveys provide a ‘weather forecast’ for the next oyster season and inform five-yearly stock assessments.

Oyster mortality rates during 2013–15 were high, but the 2016 survey showed mortality rates had fallen to very low levels, approximately 4% of the fishery population. BOMC uses the information from annual surveys to set harvest levels and predict catch rates. The annual survey of population size and disease status forms a time series that complements the larger, five-yearly stock surveys used for assessment modelling. Currently, these models provide projections of the future status of the fishery up to three years in advance, based on levels of harvest and disease mortality.

NIWA, with the support of BOMC, are further developing the stock assessment model, increasing understanding of the fishery and disease, and the data required to reliably predict where and when deaths will occur. The result is that vulnerable areas can be fished preferentially to those with low infection, making use of oysters that would have otherwise died, reducing the spread of infection, and allowing slowly vulnerable areas to rebuild further before being fished.

Like weather forecasting, the reliability of the fishery modelling is providing confidence that the harvest levels set for the fishery are sustainable and have no effect on its ability to rebuild after disease events, and demonstrating that it is disease mortality and recruitment that drives population dynamics.

The reliability of the modelling provides confidence to stakeholders, regulators and the public that sustainable management of this significant fishery is based on robust science and accurately predicting future trends.

Iwi sustainable development aspirations aided by CRI collaboration

Maniapoto iwi are intent on using the natural resources found in the tribal rohe on the western side of the central North Island to drive economic growth – within the rohe and the region as a whole.

To support this aspiration, the Maniapoto Māori Trust Board (MMTB) secured funding from the Ministry for Primary Industries (MPI) through the Sustainable Farming Fund (SFF) to assess the resources available across the rohe.

This was achieved through a project known as Ngā Aho Rangahau Ō Maniapoto – the name conveys the idea of bringing several strands or threads of research together in an organised and logical manner to deliver useful outputs.

Six Crown Research Institutes, led by NIWA, were commissioned by MMTB to analyse and integrate biophysical resources data, and characterise Māori land in the rohe. The assessment also identified potential constraints on resource use, such as slope and water availability, and hazards, such as land slips and flooding.

The project team also undertook a high-level economic analysis of the land uses preferred by the iwi to drive growth – apiculture, forestry, horticulture and sheep- and goat-milking. This analysis will form a foundation for future investment decisions by the iwi.

The project was a test case for CRIs, requiring them to work together across disciplines to identify economic opportunities for a client. It proved that an integrated assessment undertaken by a well-managed, multi-disciplinary team could yield better outcomes than those achieved by a series of single-discipline assessments.

It also demonstrated how broad-scale resource assessments can be used to guide commercial decision making.

The project highlighted challenges inherent in transforming data and information held within individual organisations into useful and valuable outputs for a client and its stakeholders. The importance of involving Māori landowners in discussions regarding land use was reinforced.
OUTCOME 2

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

NIWA data powering hydroelectric industry

New Zealand’s hydroelectricity industry is using a broad range of NIWA’s data and data capture capabilities to better manage generation, operations, efficiency and resource consent compliance.

NIWA’s data and information takes in hydropower catchment climate, water flows and levels, sediment amounts, water quality and status of aquatic ecosystems.

In particular, NIWA operates river and lake water-level recorders for all the major hydroelectric power companies in New Zealand. Water-level and river-flow data are transmitted to hydropower companies using telemetry systems in near real-time.

The spread of the companies across the country is very well matched by NIWA’s 14 field offices, where specialist environmental monitoring staff use quality-assured procedures to ensure time-series data are high quality and without gaps.

NIWA’s ongoing capital investment in water-level recorders and new monitoring equipment and systems is providing reassurance to the hydroelectricity industry that data supply is continuous and fit-for-purpose.

As well as supplying water-level and river-flow data to each hydropower company to assist in operations, NIWA uses the data to provide the New Zealand Stock Exchange with a daily bulletin of information on the country’s lake inflows and storages – to advise industry of the status of the country’s fluctuating hydropower inflows and storages. This allows hydropower companies to schedule electricity generation operations and allow the country to make the most efficient use of its largest, but finite, source of electricity.

Water flow control at Benmore Dam.
Chris Sisarich
Commercial partnership to help boost solar energy uptake

Solar energy (insolation) currently contributes less than 0.1% of all electricity generated in New Zealand, according to the Energy Efficiency and Conservation Authority (EECA).

Until recently, the cost of installing solar technology has hindered strong growth. However, EECA expects an acceleration in interest and uptake in the near future, as costs steadily reduce.

A dearth of consumer-friendly information on the amount of solar energy available for electricity generation at different locations and times has also inhibited growth. Such information is vital, to help home and business owners check the economics of installation before committing to the investment. EECA has identified NIWA’s SolarView calculator as a tool ideally suited to filling that void.

During the year, NIWA and EECA successfully negotiated a commercial agreement that will see, by the end of 2016, SolarView included as an online calculator on EECA’s consumer website and promoted via EECA’s regular ‘Energy Spot’ campaign on television.

SolarView provides information about New Zealand’s solar energy resource, independent of changes in solar technology over time. It provides location-specific information, rather than the general guidance offered by many other web-based industry calculators.

The tool estimates the average amount of insolation available to power each square metre of solar panels at any location in New Zealand, at different times of the day and year.

Users simply enter their street address, or click on a location on the embedded Google Maps link, and then specify the tilt and bearing of their roof or panel-bearing surface. SolarView then factors in surrounding terrain and taps into NIWA’s comprehensive climate database to accurately depict the sun’s path from sunrise to sunset at five representative dates during the year, including summer and winter extremes. It also plots hourly measurements of cumulative insolation in kilowatt hours (kWh) per square metre on each path.

SolarView also offers guidance on how to plot nearby obstructions, like buildings and trees, on to the profile, and calculate any effect of their shade on available insolation. Homeowners and solar energy specialists can use this information to determine how much money solar panels or a solar water heating system might save them. The tool also helps determine the optimum location for panels on any roof, given the unique surroundings and situation of each home.

SolarView was developed at NIWA’s atmospheric research site at Lauder, the best-instrumented station in the Southern Hemisphere for solar radiation research. Lauder also now has 72 solar panels on its main building, producing more than 18 kWh at their peak, and is on track to pay back the installation cost in less than a decade. The record of power generation by the panels will be used in conjunction with the wide range of radiation research products to further refine tools for solar energy information.

For more information on SolarView: niwa.co.nz/our-services/online-services/solarview

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Solar panel installation.
OUTCOME 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.

Turning forecasts into an app for melanoma patients

NIWA data are now being used to help melanoma patients and the wider public via an app that provides forecasts on the UV Index (UVI).

Called uv2Day, the free app covers selectable locations in New Zealand, Australia, the South Pacific and Antarctica, providing the current UV level, the peak for the day and progression throughout the day. With New Zealand having the highest rates of skin cancer in the world, the app is an example of a practical tool able to deliver real-time information to end users.

Developed in conjunction with the Cancer Society in response to a request from melanoma patients needing detailed information about UV levels, uv2Day forecasts are provided for clear skies and for predicted cloudy conditions.

The app also includes messages on the corresponding time it would take for sensitive skin to show effects of UV damage, and is useful for planning activities to optimise sun exposure and as an educational tool about what UVI means. NIWA has been publishing daily UVI forecasts on its website for a number of years.

The main determinant of UVI is the elevation angle of the sun above the horizon, so UVI values are greatest in summer and can exceed 14 – about twice as high as in the UK. It is recommended sunscreen is applied whenever UVI is greater than 3.

The UV data are calculated using a radiative transfer model, and the ozone fields used as inputs to the model are forecasts based on global measurement from NOAA satellites. In the New Zealand region, estimates of UVI that include cloud effects are also derived from a weather model that is run daily at NIWA.

UV2Day app.
Dave Allen
Preparing for rising seas

The impacts of climate change on New Zealand are well known, but it is also widely acknowledged that more work needs to be done at a local level to adapt to these changes.

This expectation of rising seas, tides, and storm surges reaching further inland caused more frequent and extensive flooding, as well as erosion and rising groundwater, prompted a report from the Parliamentary Commissioner for the Environment published in November 2015.

The purpose of the Preparing New Zealand for Rising Seas: Certainty and Uncertainty report was to increase understanding of how sea-level rise will affect New Zealand.

NIWA was commissioned to contribute two substantial pieces of work that form the basis of this report. One looked at national and regional risk exposure in low-lying coastal areas, while the other analysed the effect of sea-level rise on the frequency of coastal inundation. The analysis on national regional risk exposure marked the first consistent attempt at quantifying the risk exposure for low-lying coastal areas and enabling a comparison between regions and urban areas. It was essentially a stocktake of what is at stake within specific land elevation bands of our coastal margins above the average spring-tide level.

NIWA scientists used laser-based aerial scanning datasets for measuring elevations, known as a LiDAR survey, along with asset/building information from RiskScape to produce the stocktake. The results, for regions where LiDAR data were available, revealed that in the low-lying 0–1.5 metre elevation range, it would cost about $19 billion to replace existing buildings. In areas 0–3 metres high, the replacement cost of all buildings exposed rises to $52 billion. Infrastructure such as roads, wharves and airports were also counted (kilometres for roads and railways), but not costed.

This information provided by NIWA is now assisting in the prioritisation of national and regional efforts to adapt to more frequent coastal hazard impacts from rising seas.

Preparation for rising seas

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Moving out of the path of tsunamis

Samoans are moving buildings and infrastructure out of the way of rising seas, coastal erosion, storm surges and tsunamis.

The village of Sa’anapu on the south coast of Samoa’s Upolu Island has already been forced into an unplanned move inland by the erosion of almost 1 metre of seafront each year and the effects of Cyclone Evans in 2012 and the 2009 tsunami.

This year, NIWA and Boinnfrat-Giesen Architects of Wellington completed the first ‘reconnaissance’ phase of a project to help the villagers stage an orderly move inland that retains the essence and vitality of their community.

The project is a collaboration by the village with scientists, architects and anthropologists, and is funded by the French Pacific Fund with support from the Samoan government.

The original village was built on the sandy foreshore, between a mangrove reserve and a protecting sea reef. Over time the village expanded inland. The project aims to facilitate a smooth expansion even further inland. The first phase saw the team and Tofa Talii Popese Lopaana (aka, Tupu) talking chief of Sa’anapu collect data about the village history within its natural environment. They assessed village life, building types and the topography of the coastal zone to develop physical models of the village and numerical models of the effect of tsunamis. The aim is to help the villagers plan a shift away from the hazardous coastal zone by proposing solutions that feel like a natural, yet improved, extension of the village.

A particular challenge will be the village’s close connection with both reef and mangrove reserve. They are food sources and have strong cultural significance, and the mangrove reserve also holds freshwater springs.

The exceptionality of this low-key project was captured in a unique exhibition put together by the project members. It was intended to help raise funding for the building stage, and to showcase how the collaborative nature of the project had generated a plan in sympathy with the lives and aspirations of the villagers.

Sa’anapu village representatives meet with NIWA’s Geoffroy Lamarche (right).
Our Future Climate NZ – a new tool to aid climate change preparation

As this century progresses, climate change is expected to impact significantly on the New Zealand economy. As mean temperatures rise, precipitation patterns alter and extreme weather events such as floods, wind storms and dry spells increase in frequency and intensity, weather-dependent sectors – particularly agriculture – will need to adapt to ensure survival.

A review cited in a speech by the Secretary to the Treasury suggests that, overall, climate change could result in a 20% reduction in GDP per capita. Other commentators are more conservative, noting that climate change will offer some businesses the opportunity to grow. Where observers agree, however, is that early action to adapt to and prepare for climate change will incur considerably less cost in the long term than a reactive approach.

Meaningful climate data are critical to ensuring business leaders can analyse potential impacts and plan accordingly. NIWA has developed a new online portal that enables users to view and download temperature and rainfall projections from a range of global climate models, according to a number of greenhouse gas concentration scenarios, and across different spatial and temporal scales.

The portal, called Our Future Climate NZ (ofclnz.niwa.co.nz), presents data as national maps, charts for 15 representative urban centres and downloadable datasets. Users select the climate model, greenhouse gas concentration scenario, climate variable, location and timescale using simple checkboxes. Data update immediately, with datasets downloadable as versatile csv files.

Our Future Climate NZ is a free service, and is expected to be live by the end of 2016. Further development of the portal is planned, including the addition of climate parameters such as wind, solar radiation, and relative humidity, and derived variables such as potential evapotranspiration, growing degree days, and the number of frost days.

The portal adds to NIWA’s comprehensive range of tools and services aimed at helping New Zealanders adapt and build resilience to climate variability and change. See niwa.co.nz/our-science/climate for more information.

A storm approaches Wellington.
Dave Allen

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A NIWA report shows that climate change will affect all New Zealanders – where they work and where they live and play.

At its worst, the number of days hotter than 25°C could double by 2040, and triple by 2090.

The new report was prepared for Ministry for the Environment (ME) to help the nation understand how to respond and adapt to climate change. It was based on climate models in the Fifth Assessment Report of the International Panel of Climate Change (IPCC).

The modelling showed that for the most conservative IPCC scenario temperatures would rise by 0.7°C degrees by 2040. Higher emission scenarios increased temperature by 1°C by 2040, and 3°C by 2090.

Impacts could include higher deaths in summer due to heat, business disruption from droughts, and flood damage to infrastructure from intense winter rain.

The increased temperatures would hit at the heart of New Zealand’s agricultural economy. Drought severity was projected to increase in most regions, with hotter temperatures worst in the North Island. New Zealanders would also feel the effects in their leisure pursuits. Less skiing would be possible because of 30 fewer ‘snow days’ a year. Strong winds and intense rainfall would disturb outdoor activity. NIWA’s team looked at 40 different climate models to estimate what the increase could mean for New Zealand’s climate. It then applied the six models best suited to New Zealand to simulate what would happen on a regional basis over 150 years, from 1971 to 2120, under each of the IPCC’s four scenarios of CO₂ atmospheric concentrations.

The extensive regional modelling means the new information is the most robust and regionally specific yet achieved. The regional climate models alone produced three terabytes of data – the equivalent of more than 4000 CDs of information.

The report and data have fed into work by the MBIE-funded Climate Change Impacts and Implications (CCI) programme. NIWA has also produced numerous regional reports for a range of regional councils, to help in their long-term planning.

A related hydrology report is expected during 2016/17, assessing how changes to rainfall will affect waterways and other paths in the hydrological cycle.

Oriental Bay, Wellington when the sun shines.

Dave Allen
OUTCOME 5

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

Tool helps decision making in freshwater collaboration

The government’s freshwater reforms encourage regional councils to collaborate with their communities to develop plans for the management of rivers, lakes and wetlands.

Planning committees made up of representatives of the local community or stakeholder groups are deciding on targets and bottom lines for water quality, water quantity and habitat quality.

A big challenge in collaborative planning is to deliver complex science in a way that supports decision making, but doesn’t overwhelm people with complexity. NIWA is using a Bayesian networks tool to show committees the probability of a certain outcome given the probabilities of the various factors known to affect it.

For example, the tool might show the probability of a toxic algae bloom given the probabilities of certain phosphorus and nitrate concentrations, fine sediment cover and flood frequency. It also shows how these factors are affected by decisions on land use, such as forestry and riparian buffer strips, and developments like a new dam.

The cause-effect links are based on the best knowledge available from scientific data, models and expert opinion.

The planning committee is able to see the consequences of different management and policy decisions on the values they have identified. In 2015, NIWA produced a generalised Bayesian network for large gravel-bed rivers for the Ministry for the Environment. It provides a framework and starting point for regional councils to develop networks for specific catchments.

NIWA is working with councils to customise this network in three collaborative processes – the Ruamahanga and Porirua Whaitua in the Greater Wellington region, and the TANK process in the Greater Heretaunga area of Hawke’s Bay. The use of Bayesian networks as a decision-support tool is expected to increase as more councils turn to community collaboration for freshwater management.

*Takaka River.
Dave Allen*
Eradicating a major aquatic weed

The world’s worst submerged weed is no longer detected in New Zealand lakes. Extensive searches by NIWA divers in April 2016 failed to detect hydrilla since herbivorous grass carp were introduced there in 2008.

This significant achievement is the result of decades of work and a huge collaborative effort between NIWA, the Ministry for Primary Industries (MPI), the Department of Conservation, Hawke’s Bay Regional Council, iwi and the local community.

Hydrilla was first discovered in a northern Hawke’s Bay lake in 1963, but is thought to have been there since the 1920s. It is a major aquatic weed in the US, choking lakes and waterways and costing hundreds of millions of dollars in prevention and eradication programmes.

The New Zealand strain was not only highly invasive, but also incredibly difficult to control because the only herbicide registered for aquatic use failed to even check its growth. NIWA identified endothall as a safe and effective herbicide and coordinated an application.

Making the best use of freshwater

NIWA’s science is helping communities decide how to best use the freshwater in rivers and streams.

Regional councils are required to set minimum flow and water-use levels for all waterways. The intent is to balance how much water is needed in streams with how much communities need to take from them.

That requires predictions of the results of various rates of water take and minimum flow. NIWA has created tools that combine data on how much water there is, how much is needed for waterway ecosystem health, and how much people want to take out.

The Environmental Flows Strategic Assessment Platform (EFSAP) is a regional-scale planning tool that utilises flow statistics. The Cumulative Hydrological Effects Simulator (CHES) tool evaluates and compares the effects of water use on in-stream values and water-use reliability within specific catchments.

Both tools illustrate the effects of changes to water-use scenarios or allocation limits in the form of easy-to-understand colour-coded river network maps and summary diagrams or tables.

At the West Coast Regional Council, EFSAP was used to simulate the consequences of minimum flow and total allocation limits on nine catchments. The decision-support graphic showed combinations that would ensure 95% reliability of water take, while losing no more than 15% of the physical habitat of key species such as brown trout, eels, mayfly and inanga.

The results showed that the use of the proposed National Environmental Standard (NES) limits would generally reduce reliability of water supply, but improve the availability of physical habitat for key species.

EFSAP has been used by Environment Canterbury, Greater Wellington Regional Council, Bay of Plenty Regional Council, and West Coast Regional Council.

Hydrilla. Rohan Wells

Hydro canal depth gauge. Dave Allen
The ozone hole and UV intensity

This year New Zealand became the unfortunate world leader in rates of invasive melanoma, a type of skin cancer caused by exposure to UV light. There are about 50 cases per 100,000 people.

Ironically, it was also a year for good news. The Government started funding immune-therapy treatments for advanced melanoma, and the Massachusetts Institute of Technology (MIT) confirmed the Antarctic ‘ozone hole’ was shrinking, thanks to the Montreal Protocol that had first regulated chlorofluorocarbons in the late 1980s. Their emissions have subsequently been reduced to almost zero.

NIWA’s research stations at Lauder and in Antarctica first began making ozone measurements in the 1980s, informing the Protocol discussions. The continued sparsity of measuring sites in the Southern Hemisphere meant Lauder’s ongoing monitoring is critical to understanding mid-latitude ozone.

NIWA scientists warn that a now slowly shrinking Antarctic ozone hole is not the end of concern for UV-induced skin cancer in New Zealand. UV intensity in New Zealand is 40% higher than at comparable northern latitudes in southern Europe or the US. Man-made ozone depletion, which is more intense in the Southern Hemisphere, is only to blame for about 3% of the difference.

About half the difference is due to the Earth’s orbit and differences in ozone high in the atmosphere and near the surface. The rest of the UV difference is the subject of ongoing research by NIWA at Lauder. It may be some combination of cloud and aerosol particles from natural processes and human activity.

Whatever the reason for the UV strength, Lauder helps people assess the risk and degree of cover they need by publishing a UV index. The index models a wide range of factors, such as sun angle and clouds, is updated every 15 minutes, and is available free online (see page 82).

Ozone affects the dynamics and photochemistry of the global atmosphere, so its interplay with global warming is also subject to ongoing research at Lauder.

Investigating the increase in ocean acidity

The ocean’s pH has decreased by 26% since the start of the industrial revolution. This ‘acidification’ reflects the increased absorption of atmospheric CO₂ by the oceans, and is a direct consequence of the higher concentrations generated by human activities.

The impact is likely to be seen from the coast to the deep ocean, but there are many unknowns about the large-scale effects, because sea ecosystems are complex and interdependent.

Therefore, one NIWA study has gone to the bottom of the food chain, at the bottom of the world, to find out how the most basic of organisms might fare under acidification. That will help us appreciate what might happen to marine life higher up the food chain – such as the fish that form part of our diet and export earnings.

The three-year study, funded by the Marsden Fund, looked at the effect of acidification on sea-ice algae. They live as highly concentrated films on the underside of Antarctic sea ice in spring and summer. Productivity of these algae is critical to the local marine food web.

These ice-associated algal communities are practically impossible to study in a lab, so NIWA designed and built ‘mini-labs’ to take to them. Dome-shaped chambers were placed on the underside of sea ice in the −1.9°C waters of McMurdo Sound, Ross Sea. Scientists changed the living conditions of algae inside the chambers to match pH levels predicted in the coming decades, and measured how the algae responded.

After two seasons of experiments, initial results suggest that ice algal primary productivity increases under ocean acidification. This illustrates that they may have a role in the mediation of CO₂ uptake by the environment, and could influence other parts of the ecosystem through their greater use of nutrients available in the cycle.

The preliminary results were presented at international symposiums in 2016, where the audiences were equally fascinated by the results and the pioneering in situ chamber experiments.

Under the ice, Antarctica.

Peter Marriott
Deep South

The mission of the Deep South National Science Challenge is to enable New Zealanders to adapt, manage risk and thrive in a changing climate.

Key to achieving this aim is a deeper understanding of the interacting physical and chemical processes in the atmosphere, oceans, sea ice and land that drive our climate. The Deep South Challenge centres on the development of a sophisticated computer model – the NZ Earth System Model (NZESM) – that will numerically mimic these processes and enable researchers to predict how our climate may change over different timeframes and under different influences.

This year, NIWA installed the NZESM on to its supercomputer, employed new staff to run it and carried out an initial series of tests.

Work to establish the NZESM is being supported by observations and other innovative research into processes in the Southern Ocean and Antarctica, and the overlying atmosphere.

This research utilises NIWA’s existing expertise in atmospheric chemistry, sea ice, physical oceanography and historical data recovery, and is possible through the alignment of NIWA research funding to support the Challenge. Vision Mātauranga sits across all aspects of the Challenge, and has made a significant investment in Māori-led climate research.

The Challenge is led by NIWA oceanographer Dr Mike Williams, who took up the role from the inaugural director Professor Dave Frame on 1 September 2016.

Principal Scientist Olaf Morgenstern works on a new climate modelling system.

Dave Allen

Sustainable Seas

The aim of the Sustainable Seas National Science Challenge is to enhance the use of New Zealand’s marine resources, within environmental and biological constraints.

The research and activities of the Challenge take an Ecosystem-Based Management (EBM) approach to managing our marine resources. EBM integrates management of natural resources, recognises the full array of interactions within an ecosystem (including human), and promotes both sustainable use and conservation in an equitable way.

Initiatives using this approach will potentially include product certification and provenance, increased investment, enhanced diversification, and an increased social licence to operate. In addition, the Challenge will support the development of new environmentally sustainable technologies and activities that will add value to the marine economy.

Sustainable Seas is led by NIWA scientist Dr Julie Hall, who is supported by a team of programme leaders for each of the five programmes within the Challenge – Our Seas, Valuable Seas, Tangaroa, Dynamic Seas, and Managed Seas. Support is also provided for the cross-programme elements of communication and outreach and Vision Mātauranga.

Senior NIWA scientists lead the Our Seas, Valuable Seas and Managed Seas programmes, 5 of the 17 Challenge projects that are now underway, and are also involved in an another 6 projects.

In addition, NIWA is making a very significant contribution to the Challenge by aligning NIWA-funded research projects with the Challenge objective.

Marine survey near Kapiti Island using Ikatere.

Dave Allen
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 SCP outcome area are given on pages 75–89.

The Statement of Core Purpose (SCP) 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.

Snapper up close at Poor Knights Marine Reserve. Crispin Middleton
## Aquaculture

### MBIE priority area: Primary industry productivity and sustainability

<table>
<thead>
<tr>
<th>SCI programme</th>
<th>Sector benefits</th>
<th>SCP outcome No.</th>
<th>Core funding investment ($) Budget, 2015</th>
<th>Core funding investment ($) Actual, 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop reliable and efficient techniques for commercial-scale production of established and emerging high-value aquaculture species</td>
<td>Production information and economic models that enable robust investment decisions to be made by commercial investors carrying out due diligence processes for aquaculture opportunities, as well as assisting national and regional government agencies supporting the commercialisation process. This includes existing species such as chinook salmon and mussels, and new species on the point of commercialisation such as kingfish and hapuku. Also, advice and technical support for industry to facilitate optimisation of their commercial operations by dealing with issues that affect profitability.</td>
<td>1</td>
<td>3,245,141</td>
<td>3,055,935</td>
</tr>
<tr>
<td>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</td>
<td>Provision of services to central and local government, and industry, to facilitate decision making on water-space allocation, marine farm siting, and monitoring protocols and guidelines. For example, a mussel-yield forecast system for an area of the Marlborough Sounds gives industry advance information on productivity and yield, contributing to improved planning and economic returns. The research also facilitates increased public engagement and understanding of the actual environmental effects of aquaculture.</td>
<td>1, 5</td>
<td>1,148,900</td>
<td>1,148,900</td>
</tr>
</tbody>
</table>

## Fisheries

### MBIE priority area: Primary industry productivity and sustainability

<table>
<thead>
<tr>
<th>SCI programme</th>
<th>Sector benefits</th>
<th>SCP outcome No.</th>
<th>Core funding investment ($) Budget, 2015</th>
<th>Core funding investment ($) Actual, 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td>Application of state-of-the-art tools for monitoring and predicting changes in fish populations, biomass, and size and age composition, and for increasing the efficiency of data analysis and presentation. Stakeholders have the tools and information necessary to make robust decisions on fisheries management. Consequently, New Zealand fisheries are recognised internationally as sustainably managed, which brings enhanced market opportunities, and this programme is an important contributor to that recognition.</td>
<td>1</td>
<td>660,000</td>
<td>660,000</td>
</tr>
<tr>
<td>Develop and apply standardised methodologies to monitor and assess international fisheries outside the New Zealand EEZ and determine the environmental effects of fishing</td>
<td>Enabling New Zealand’s leadership in the effective management and sustainability of the toothfish fishery in the Ross Sea region, which continues to be accredited. Scientific information and advice supports New Zealand (e.g., central government) and international (e.g., Commission for the Conservation of Antarctic Marine Living Resources, South Pacific Regional Fisheries Management Organisation, and FAO) organisations.</td>
<td>1</td>
<td>65,000</td>
<td>65,000</td>
</tr>
</tbody>
</table>
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 & Oceans National Centre

Methods and tools that facilitate stakeholder collaboration in developing actions that will enhance the economic benefits arising from New Zealand’s natural marine resources. For example, risk assessment methodologies for fish species allow central government to develop risk assessment protocols. A range of tools is used to efficiently deliver information to end users. This work aligns strongly with the Sustainable Seas National Science Challenge.

Develop approaches to enhance fisheries value and improve market access

Added value to New Zealand fisheries through making better use of currently exploited stocks. Research this year will inform the development and testing of bycatch reduction approaches, and enable iwi to develop an iwi-based shellfish monitoring programme, with ongoing survey data for investigating factors affecting the abundance of intertidal shellfish of specific concern to Maori and other stakeholders.

### Coasts and Oceans

**MBIE priority areas: Marine resources and ecosystems; Mineral resources**

<table>
<thead>
<tr>
<th>SCI programme</th>
<th>Sector benefits</th>
<th>SCP outcome No.</th>
<th>Core funding investment ($), Budget, 2015</th>
<th>Core funding investment ($), Actual, 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td>Improved knowledge of the shape and composition of the seabed, and improved access by industry and government agencies to seafloor data, which enables better management of the environment and utilisation of seabed resources. For example, data have been processed and interpreted for a wide variety of stakeholders, who have used the data for infrastructure developments, environmental baseline monitoring, and hydrographic purposes.</td>
<td>1, 5</td>
<td>1,896,905</td>
<td>1,729,255</td>
</tr>
<tr>
<td>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</td>
<td>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, fishes, 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 for enhanced stewardship of New Zealand’s marine estate, particularly in relation to biodiversity and biosecurity management.</td>
<td>5, 6</td>
<td>1,824,553</td>
<td>1,724,553</td>
</tr>
<tr>
<td>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</td>
<td>The influence of physical, chemical and biological processes on marine community structure, function and production, together with critical time series of coastal (e.g., Firth of Thames) and deeper ocean waters, allows natural variability to be separated from anthropogenically induced changes (e.g., ocean acidification). Understanding and predicting such impacts allows stakeholders to define the environmental and biological constraints and manage activities to maximise marine resource use.</td>
<td>5, 6</td>
<td>1,582,000</td>
<td>1,617,000</td>
</tr>
</tbody>
</table>
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. Ecosystem and oceanic indicators for marine “State of the Environment” reporting have been developed and will be critical to New Zealand’s reporting of the states, pressures and impacts on our marine environment.

Enhanced protection and restoration of marine biodiversity through the use of new techniques for measuring, understanding and monitoring marine systems. Guideline values for sedimentation in estuaries will be used to manage estuaries and protect them from the adverse effects of land-based sediment inputs. 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 make decisions that balance resource use and the maintenance of biodiversity when there are multiple resource users with varying societal, economic and cultural values.

A wide variety of novel tools and information enable robust estimates of aquatic biosecurity risks, effective pest surveillance and monitoring, and the development and implementation of effective, socially and environmentally acceptable mitigation options. For example, models of the effectiveness of management campaigns in reducing the domestic spread of biofouling organisms enable regional councils to design tools for use in domestic pathway management plans across New Zealand. The programme supports interventions at different points in the biosecurity system; from prevention through to mitigation of impacts.

Freshwater and Estuaries

**MBIE priority area: Land and freshwater resources**

<table>
<thead>
<tr>
<th>SCI programme</th>
<th>Sector benefits</th>
<th>SCP outcome No.</th>
<th>Core funding investment ($) Budget, 2015</th>
<th>Core funding investment ($) Actual, 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water resources: understanding and predicting the hydrological cycle (how much water, where and when) to improve water management</td>
<td>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, snow and climate information supports DOC’s avalanche warning programme and allows electricity providers to monitor snow storage in their hydro catchments and estimate water resources in snow form before and during the irrigation season.</td>
<td>1, 5</td>
<td>155,000</td>
<td>155,000</td>
</tr>
<tr>
<td>Benefit Area</td>
<td>Details</td>
<td>Funding</td>
<td>Cost 1</td>
<td>Cost 2</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
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</tr>
<tr>
<td><strong>Sustainable water allocation:</strong> understanding and predicting effects of human use and modification of rivers and groundwater systems for sustainable allocation</td>
<td>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 applied by end users for water management planning and decision making. For example, the Environmental Flows Strategic Allocation Platform assists regional councils across the country in large-scale water management decision making. Guidance and assistance with defining environmental limits for the National Objectives Framework, and to inform consenting decisions.</td>
<td>1, 5</td>
<td>1,996,000</td>
<td>1,886,000</td>
</tr>
<tr>
<td><strong>Causes and effects of water quality degradation:</strong> 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</td>
<td>Support implementation of the National Policy Statement for Freshwater Management (NPS-FM) and National Objectives Framework (NOF). For example, statistical techniques for risk assessment and environmental reporting, new toxicological results for nitrate in freshwater, and catchment models, have been provided and applied for policy assessment, planning, and community deliberation in the NPS-FM in multiple locations.</td>
<td>1, 5</td>
<td>453,200</td>
<td>689,290</td>
</tr>
<tr>
<td><strong>Catchments to estuaries:</strong> understanding and predicting the functional connections between catchments and estuaries to improve diffuse-source contaminant management</td>
<td>Provision of direct support for the implementation of limits-based management of estuaries, and increased access to science-based tools for regional council managers. This includes the application of the CLUES estuaries tool, which was developed to give greater flexibility in setting scenarios for investigating potential ecological impacts in estuaries. The tool has been used by one regional council to identify at-risk estuaries, and in another region to compare seasonal nutrient loadings, thus informing land management planning to improve estuarine water quality and health.</td>
<td>5</td>
<td>300,000</td>
<td>401,940</td>
</tr>
<tr>
<td><strong>Freshwater biosecurity:</strong> identifying and evaluating threats from non-indigenous species, minimising risks of their establishment, and developing tools to mitigate their impacts</td>
<td>Reduced threat and spread from invasive aquatic plant species in major catchments and lakes 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. For example, the world’s worst submerged weed was once in four New Zealand lakes, and is now no longer detected here. This is the final outcome of advice on management tools and options based on years of NIWA research that enabled end users to optimise eradication strategies.</td>
<td>5</td>
<td>650,000</td>
<td>469,500</td>
</tr>
<tr>
<td><strong>Ensuring ecosystem health:</strong> developing techniques for biodiversity enhancement, rehabilitation and protection of freshwater values under future economic growth scenarios</td>
<td>Provision of techniques for protecting, enhancing and rehabilitating the biodiversity of freshwater ecosystems and the cultural values they provide. Among other things, this small core funded component supports contestable research on seagrass, enabling restoration programmes to be optimally designed and well implemented. Restoration of seagrass in New Zealand estuaries has widespread benefits covering biodiversity, climate change, fisheries, water quality, aesthetic and cultural services.</td>
<td>5</td>
<td>130,000</td>
<td>192,540</td>
</tr>
</tbody>
</table>
### Hazards

#### MBIE priority area: Hazards

<table>
<thead>
<tr>
<th>SCI programme</th>
<th>Sector benefits</th>
<th>SCP outcome No.</th>
<th>Core funding investment ($)</th>
<th>Core funding investment ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop predictive models of weather-related hazards and incorporate them into an operational multi-hazard forecasting system</td>
<td>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). The forecasting system has much wider benefits than in forecasting hazards; for example, accurate, real-time and fine-scale weather data and forecasts enable on-farm operational decisions that maximise returns and reduce risks to both farm assets (property, livestock and crops) and the environment (e.g., nutrient runoff).</td>
<td>3</td>
<td>3,410,000</td>
<td>3,202,000</td>
</tr>
</tbody>
</table>

| Evaluate the risk, impacts and potential losses due to weather-related hazards to inform planning for risk reduction and emergency response | Informed decision making in New Zealand and the Pacific Islands on managing or planning for the adverse effects of weather-related and marine geological natural hazards, based on quantitative natural hazard impact and loss modelling. Local government plans, regional policy statements, unitary plans and engineering and subdivision development standards are based on, and include, products, services and tools (e.g., hazard exposure maps, risk-exposure assessments, wind-speed multipliers for the wind-action code, and updated flood estimation techniques). The Resilience to Natural Hazards and Deep South National Science Challenges will provide further opportunities to apply risk-assessment tools and processes into collaborative community processes, thereby leading to more sustainable and acceptable approaches to reducing risk from natural hazards for New Zealand and Pacific Island communities. | 3               | 1,180,000                   | 1,220,000                   |

### Climate and Atmosphere

#### MBIE priority areas: Climate and atmosphere; Antarctica

<table>
<thead>
<tr>
<th>SCI programme</th>
<th>Sector benefits</th>
<th>SCP outcome No.</th>
<th>Core funding investment ($)</th>
<th>Core funding investment ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td>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) contribute to international databases and are used by the international atmospheric research community to detect composition variability and change, test climate models, and provide research products for satellite validation and UV exposure applications. 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. There are strong linkages to the Deep South National Science Challenge, especially in linking model development with international partners.</td>
<td>4, 6</td>
<td>2,384,500</td>
<td>2,384,500</td>
</tr>
</tbody>
</table>
Quantify New Zealand’s greenhouse gas emissions to improve national inventories and validate mitigation options

Long-term, high-precision measurement of CO2 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. Responding to IPCC emission guidelines, assessment at a national scale through atmospheric modelling methods provides independent evaluation of national greenhouse gas inventories.

Determine the role of oceans in governing climatically important gases and aerosols, and thereby improve global models

Data on the variability of CO2 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. For example, there is increased stakeholder and public awareness and interaction on ocean acidification through establishment of, and stakeholder involvement in, the New Zealand Ocean Acidification Observing Network (NZOA-ON), which has been identified internationally as a model for other national monitoring systems. The programme also supports the Deep South National Science Challenge.

Observe and analyse the climate of the New Zealand region, including Antarctica, to determine how the dynamics of the climate system influence 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 modelling, 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. Quality control of the observational data, their subsequent analysis, interpretation, and use in authoritative statements about the current climate are critical for accurate and timely reporting to national, central and local government agencies, vulnerable sectors, businesses, and communities. Key information is used by the government, community and researchers here and overseas to better manage lives and businesses.

Develop improved predictions of climate and climate extremes on all timescales through dynamical modelling 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. Monthly seasonal climate outlooks for the southwest Pacific promotes community awareness and better planning for climate hazards, particularly water resources under stress during El Niño conditions. Information has fed specifically into decision-making on adverse event drought declarations.
Determine present and future vulnerability, impacts and adaptation options to climate variability and changes in New Zealand, the Southwest Pacific, Southern Ocean and Antarctica

Access to better, more easily understood, and more policy-relevant, information for climate-sensitive end users, particularly when there are immediate needs (e.g., during a drought). 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/hapu, central government, research institutes, media and the general public to inform, manage and plan their activities. Refined and more useful products and services help realise the long-term goal of reduced community vulnerability to the risks of climate variability, extreme events, and climate change.

Determine the impacts of air pollutants on human health and evaluate mitigation options

The adoption of monitoring approaches to support modelling by local and central government, and the demonstration of the utility of distributed monitoring networks within the CONA (Community Observation Networks for Air) initiative, lay the groundwork for a substantial change in the way air quality is monitored, assessed and managed in the future. They place more emphasis on data comparability and causal links between economic activity, policy and emissions, and allow more rapid evaluation and feedback to managers and communities. CONA is receiving international attention for its unique combination of citizen science, new technology and attention to high data quality.

Te Kūwaha

MBIE priority area: Land and freshwater resources

<table>
<thead>
<tr>
<th>SCI programme</th>
<th>Sector benefits</th>
<th>SCP outcome No.</th>
<th>Core funding investment ($) Budget, 2015</th>
<th>Core funding investment ($) Actual, 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop tools for the management and restoration of aquatic taonga species</td>
<td>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, use of databases and decision-support tools for Māori, and increased access to existing scientific knowledge and tools.</td>
<td>1, 5</td>
<td>175,000</td>
<td>175,000</td>
</tr>
<tr>
<td>Develop knowledge and tools that support investment and returns from the Māori economy</td>
<td>Science expertise has been applied across various sectors and across the country to identify key opportunities and priorities for innovative Māori-specific products and Māori economic development.</td>
<td>1, 5</td>
<td>125,000</td>
<td>125,000</td>
</tr>
</tbody>
</table>
### Environmental Information

**MBIE priority area: Science collections and infrastructure**

<table>
<thead>
<tr>
<th>SCI programme</th>
<th>Sector benefits</th>
<th>SCP outcome No.</th>
<th>Core funding investment ($) Budget, 2015</th>
<th>Core funding investment ($) Actual, 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td>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. Also supports nationally consistent approaches to environmental data collection (e.g., by contributing to NEMS activities).</td>
<td>1–5</td>
<td>4,900,000</td>
<td>4,924,240</td>
</tr>
<tr>
<td>Information management: implement and maintain robust information infrastructures to provide future-proof archives for New Zealand’s climate, freshwater, marine and biological information</td>
<td>A robust information infrastructure enables NIWA’s environmental data (e.g., freshwater hydrology, freshwater biology, 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. Marine biodiversity data that are available online to the New Zealand public, industry, government and science communities through national and international data portals contribute to improved environmental and spatial management of the New Zealand marine estate.</td>
<td>1–5</td>
<td>1,330,000</td>
<td>1,330,000</td>
</tr>
<tr>
<td>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</td>
<td>Provision of internationally best-practice 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. Many New Zealand stakeholders follow the NIWA-led standard – Environmental Observations Data Profile – to enable council-held data to be integrated with a national system (Land and Water Aotearoa).</td>
<td>1–5</td>
<td>260,000</td>
<td>155,000</td>
</tr>
</tbody>
</table>

### Capability

**MBIE priority area: Capability**

<table>
<thead>
<tr>
<th>SCI programme</th>
<th>Sector benefits</th>
<th>SCP outcome No.</th>
<th>Core funding investment ($) Budget, 2015</th>
<th>Core funding investment ($) Actual, 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>National centre operations and end-user engagement</td>
<td>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.</td>
<td>1–5</td>
<td>1,768,635</td>
<td>2,796,870</td>
</tr>
<tr>
<td>Key activities to develop capability</td>
<td>Strengthened international collaboration, new skills and capabilities, transfer of expertise to NIWA and contribution to core research.</td>
<td>1, 3–6</td>
<td>2,618,738</td>
<td>2,618,738</td>
</tr>
</tbody>
</table>
## FINANCIAL STATEMENTS

<table>
<thead>
<tr>
<th>Financial Statement</th>
<th>Page</th>
</tr>
</thead>
<tbody>
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<td>Statement of comprehensive outcome</td>
<td>102</td>
</tr>
<tr>
<td>Statement of changes in equity</td>
<td>103</td>
</tr>
<tr>
<td>Statement of financial position</td>
<td>104</td>
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<td>Cash flow statement</td>
<td>105</td>
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<tr>
<td>Notes to the financial statements</td>
<td>106</td>
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<tr>
<td>Preparation disclosures</td>
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<td>Corporate governance and disclosures</td>
<td>116</td>
</tr>
<tr>
<td>Statement of responsibility</td>
<td>117</td>
</tr>
</tbody>
</table>

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*Adelie penguins, Antarctica.*

_Dave Allen_
**NIWA Group – Statement of comprehensive income**

For the year ended 30 June 2016

<table>
<thead>
<tr>
<th>in thousands of New Zealand dollars</th>
<th>Notes</th>
<th>2016 Actual</th>
<th>2016 SCI Budget</th>
<th>2015 Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue and other gains</strong></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue</td>
<td></td>
<td>130,308</td>
<td>137,038</td>
<td>126,190</td>
</tr>
<tr>
<td>Other gains</td>
<td></td>
<td>65</td>
<td>–</td>
<td>69</td>
</tr>
<tr>
<td><strong>Total income</strong></td>
<td></td>
<td>130,373</td>
<td>137,038</td>
<td>126,259</td>
</tr>
<tr>
<td><strong>Operating expenses</strong></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employee benefits expense</td>
<td></td>
<td>(63,473)</td>
<td>(65,339)</td>
<td>(60,375)</td>
</tr>
<tr>
<td>Other expenses</td>
<td></td>
<td>(47,060)</td>
<td>(50,956)</td>
<td>(43,896)</td>
</tr>
<tr>
<td><strong>Total operating expenses</strong></td>
<td></td>
<td>(110,533)</td>
<td>(116,295)</td>
<td>(104,271)</td>
</tr>
<tr>
<td><strong>Profit before interest, income tax, depreciation, and amortisation</strong></td>
<td></td>
<td>19,840</td>
<td>20,743</td>
<td>21,988</td>
</tr>
<tr>
<td>Depreciation and impairment</td>
<td>4</td>
<td>(14,006)</td>
<td>(15,502)</td>
<td>(13,684)</td>
</tr>
<tr>
<td>Amortisation</td>
<td>6</td>
<td>(813)</td>
<td>(190)</td>
<td>(694)</td>
</tr>
<tr>
<td><strong>Profit before interest and income tax</strong></td>
<td></td>
<td>5,021</td>
<td>5,051</td>
<td>7,610</td>
</tr>
<tr>
<td>Interest income</td>
<td></td>
<td>504</td>
<td>151</td>
<td>432</td>
</tr>
<tr>
<td>Finance expense</td>
<td>(33)</td>
<td></td>
<td></td>
<td>(37)</td>
</tr>
<tr>
<td><strong>Net interest and other financing income</strong></td>
<td></td>
<td>471</td>
<td>151</td>
<td>395</td>
</tr>
<tr>
<td><strong>Profit before income tax</strong></td>
<td></td>
<td>5,492</td>
<td>5,202</td>
<td>8,005</td>
</tr>
<tr>
<td>Income tax expense</td>
<td>9</td>
<td>(1,481)</td>
<td>(1,458)</td>
<td>(2,250)</td>
</tr>
<tr>
<td><strong>Profit for the period</strong></td>
<td></td>
<td>4,011</td>
<td>3,744</td>
<td>5,755</td>
</tr>
<tr>
<td><strong>Other comprehensive income (loss)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign currency translation differences for foreign operations</td>
<td>(76)</td>
<td>–</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td><strong>Total comprehensive income for the period</strong></td>
<td></td>
<td>3,935</td>
<td>3,744</td>
<td>5,795</td>
</tr>
<tr>
<td><strong>Profit attributable to:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owners of the Parent</td>
<td></td>
<td>3,974</td>
<td>3,745</td>
<td>5,745</td>
</tr>
<tr>
<td>Non-controlling interest</td>
<td></td>
<td>37</td>
<td>(1)</td>
<td>10</td>
</tr>
<tr>
<td><strong>Profit for the period</strong></td>
<td></td>
<td>4,011</td>
<td>3,744</td>
<td>5,755</td>
</tr>
<tr>
<td><strong>Total comprehensive income attributable to:</strong></td>
<td></td>
<td>3,898</td>
<td>3,745</td>
<td>5,785</td>
</tr>
<tr>
<td>Owners of the Parent</td>
<td></td>
<td>3,898</td>
<td>3,745</td>
<td>5,785</td>
</tr>
<tr>
<td>Non-controlling interest</td>
<td></td>
<td>37</td>
<td>(1)</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total comprehensive income for the period</strong></td>
<td></td>
<td>3,935</td>
<td>3,744</td>
<td>5,795</td>
</tr>
</tbody>
</table>

The accompanying ‘Notes to the financial statements’ are an integral part of, and should be read in conjunction with, these financial statements.
NIWA Group – Statement of changes in equity

For the year ended 30 June 2016

<table>
<thead>
<tr>
<th>In thousands of New Zealand dollars</th>
<th>Share capital</th>
<th>Retained earnings</th>
<th>Non-controlling interest</th>
<th>Foreign currency translation reserve</th>
<th>Total equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance at 1 July 2014</td>
<td>24,799</td>
<td>78,863</td>
<td>169</td>
<td>(224)</td>
<td>103,607</td>
</tr>
<tr>
<td>Profit for the year</td>
<td>–</td>
<td>5,745</td>
<td>10</td>
<td>–</td>
<td>5,755</td>
</tr>
<tr>
<td>Translation of foreign operations</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Total comprehensive income</td>
<td>–</td>
<td>5,745</td>
<td>10</td>
<td>40</td>
<td>5,795</td>
</tr>
<tr>
<td>Dividend to equity holders</td>
<td>–</td>
<td>(4,000)</td>
<td>–</td>
<td>–</td>
<td>– (4,000)</td>
</tr>
<tr>
<td>Balance at 30 June 2015</td>
<td>24,799</td>
<td>80,608</td>
<td>179</td>
<td>(184)</td>
<td>105,402</td>
</tr>
<tr>
<td>Balance at 1 July 2015</td>
<td>24,799</td>
<td>80,608</td>
<td>179</td>
<td>(184)</td>
<td>105,402</td>
</tr>
<tr>
<td>Profit for the year</td>
<td>–</td>
<td>3,974</td>
<td>37</td>
<td>–</td>
<td>4,011</td>
</tr>
<tr>
<td>Translation of foreign operations</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>(76)</td>
<td>(76)</td>
</tr>
<tr>
<td>Total comprehensive income</td>
<td>–</td>
<td>3,974</td>
<td>37</td>
<td>(76)</td>
<td>3,935</td>
</tr>
<tr>
<td>Balance at 30 June 2016</td>
<td>24,799</td>
<td>84,582</td>
<td>216</td>
<td>(260)</td>
<td>109,337</td>
</tr>
</tbody>
</table>

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

Share capital
The Group has issued and fully paid capital of 24,798,700 ordinary shares (2015: 24,798,700 ordinary shares). All shares carry equal voting and distribution rights and have no par value.

Dividends
The dividend payment of $4 million ($0.16 per share) in the 2015 year was made to the Government of New Zealand (the Crown).
## NIWA Group – Statement of financial position

As at 30 June 2016

<table>
<thead>
<tr>
<th></th>
<th>2016 Actual</th>
<th>2016 SCI Budget</th>
<th>2015 Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EQUITY AND LIABILITIES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share capital</td>
<td>24,799</td>
<td>24,799</td>
<td>24,799</td>
</tr>
<tr>
<td>Equity reserves</td>
<td>84,322</td>
<td>83,235</td>
<td>80,424</td>
</tr>
<tr>
<td><strong>Shareholders’ interest</strong></td>
<td>109,121</td>
<td>106,034</td>
<td>105,223</td>
</tr>
<tr>
<td>Non-controlling interest</td>
<td>216</td>
<td>153</td>
<td>179</td>
</tr>
<tr>
<td><strong>Total equity</strong></td>
<td>109,337</td>
<td>108,187</td>
<td>105,402</td>
</tr>
<tr>
<td><strong>Non-current liabilities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provision for employee entitlements</td>
<td>1,001</td>
<td>1,000</td>
<td>1,012</td>
</tr>
<tr>
<td>Deferred tax liability</td>
<td>7,050</td>
<td>7,627</td>
<td>7,653</td>
</tr>
<tr>
<td><strong>Total non-current liabilities</strong></td>
<td>8,051</td>
<td>8,627</td>
<td>8,665</td>
</tr>
<tr>
<td><strong>Current liabilities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Payables and accruals</td>
<td>11,210</td>
<td>11,180</td>
<td>9,305</td>
</tr>
<tr>
<td>Revenue in advance</td>
<td>10,453</td>
<td>5,598</td>
<td>4,507</td>
</tr>
<tr>
<td>Provision for employee entitlements</td>
<td>7,482</td>
<td>7,914</td>
<td>6,656</td>
</tr>
<tr>
<td>Taxation payable</td>
<td>545</td>
<td>317</td>
<td>650</td>
</tr>
<tr>
<td>Forward exchange derivatives</td>
<td>36</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Total current liabilities</strong></td>
<td>29,726</td>
<td>25,009</td>
<td>21,118</td>
</tr>
<tr>
<td><strong>Total equity and liabilities</strong></td>
<td>147,114</td>
<td>141,823</td>
<td>135,185</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>ASSETS</strong></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-current assets</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property, plant, and equipment</td>
<td>4</td>
<td>98,782</td>
<td>106,368</td>
</tr>
<tr>
<td>Identifiable intangibles</td>
<td>6</td>
<td>1,215</td>
<td>309</td>
</tr>
<tr>
<td>Prepayments</td>
<td>38</td>
<td>–</td>
<td>19</td>
</tr>
<tr>
<td><strong>Total non-current assets</strong></td>
<td>100,035</td>
<td>106,677</td>
<td>102,540</td>
</tr>
<tr>
<td><strong>Current assets</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash and cash equivalents</td>
<td>20,328</td>
<td>11,237</td>
<td>9,863</td>
</tr>
<tr>
<td>Forward exchange derivatives</td>
<td>–</td>
<td>–</td>
<td>13</td>
</tr>
<tr>
<td>Receivables</td>
<td>7</td>
<td>17,771</td>
<td>14,609</td>
</tr>
<tr>
<td>Prepayments</td>
<td>1,900</td>
<td>2,079</td>
<td>1,942</td>
</tr>
<tr>
<td>Uninvoiced receivables</td>
<td>5,065</td>
<td>5,033</td>
<td>4,937</td>
</tr>
<tr>
<td>Inventory</td>
<td>8</td>
<td>2,015</td>
<td>2,188</td>
</tr>
<tr>
<td><strong>Total current assets</strong></td>
<td>47,079</td>
<td>35,146</td>
<td>32,645</td>
</tr>
<tr>
<td><strong>Total assets</strong></td>
<td>147,114</td>
<td>141,823</td>
<td>135,185</td>
</tr>
</tbody>
</table>

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:

Sir Christopher Mace, KNZM  Nicholas Main
Chairman  Deputy Chairman

The financial statements were authorised for issue by the directors on 16 August 2016.
NIWA Group – Cash flow statement

For the year ended 30 June 2016

<table>
<thead>
<tr>
<th>In thousands of New Zealand dollars</th>
<th>Notes</th>
<th>2016 Actual</th>
<th>2016 SCI Budget</th>
<th>2015 Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash flows from operating activities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash was provided from:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receipts from customers</td>
<td></td>
<td>132,725</td>
<td>137,754</td>
<td>128,510</td>
</tr>
<tr>
<td>Dividends received</td>
<td></td>
<td>1</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>Interest received</td>
<td></td>
<td>504</td>
<td>151</td>
<td>432</td>
</tr>
<tr>
<td>Cash was disbursed to:</td>
<td></td>
<td>(107,948)</td>
<td>(116,776)</td>
<td>(108,890)</td>
</tr>
<tr>
<td>Payments to employees and suppliers</td>
<td></td>
<td>(33)</td>
<td>–</td>
<td>(37)</td>
</tr>
<tr>
<td>Interest paid</td>
<td></td>
<td>(2,188)</td>
<td>(1,495)</td>
<td>(3,281)</td>
</tr>
<tr>
<td><strong>Net cash inflow from operating activities</strong></td>
<td>11</td>
<td>23,061</td>
<td>19,634</td>
<td>16,736</td>
</tr>
</tbody>
</table>

| **Cash flows from investing activities** |       |             |                |             |
| Cash was provided from:              |       |             |                |             |
| Sale of property, plant, and equipment |     | 64          | –              | 69          |
| Cash was applied to:                 |       |             |                |             |
| Purchase of property, plant, and equipment |  | (11,835) | (19,169)    | (14,525) |
| Purchase of intangible assets        |       | (421)       | –              | (1,118)    |
| **Net cash (outflow) from investing activities** | | (12,192) | (19,169) | (15,574) |

| **Cash flows from financing activities** |       |             |                |             |
| Cash was applied to:                 |       |             |                |             |
| Dividends paid                       |       | –           | –              | (4,000)    |
| **Net cash (outflow) from financing activities** | | – | – | (4,000) |

| **Increase in cash and cash equivalents** |       |             |                |             |
| Effect of exchange rate changes on the balance of cash held in foreign currency | | (404) | – | (291) |
| Opening balance of cash and cash equivalents | | 9,863 | 10,772 | 12,992 |
| **Closing cash and cash equivalents balance** | | 20,328 | 11,237 | 9,863 |

Made up of:

|                        |       |             |                |             |
| Cash at bank           |       | 637         | 11,237         | 1,483       |
| Short-term deposits    |       | 19,691      | –              | 8,380       |
| **Closing cash and cash equivalents balance** | | 20,328 | 11,237 | 9,863 |

The accompanying ‘Notes to the financial statements’ are an integral part of, and should be read in conjunction with, these financial statements.
1. Revenue and other gains

Revenue 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.

### 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. The point at which the significant risks and rewards of ownership transfer to the buyer may vary and will depend on the terms of each individual sale contract.

### 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. (From 1 July 2016 this funding is known as MBIE Strategic Funding).

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 $42,854 million exclusive of GST (2015: $42,841 million). All core funded projects were completed during the year.

### Uninvoiced receivables and revenue in advance
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.

Revenue received but not earned is recognised as ‘revenue in advance’.

### Judgement in applying accounting policies
As the Group recognises revenue from service contracts based on their stage of completion at balance date, where such contracts span more than one accounting period management must exercise its judgement over estimates of future contract costs and profitability. These revenues are also subject to ongoing reviews of underlying contracts to verify whether the latest estimates remain appropriate.

### Revenue and other gains

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rendering of services</td>
<td>68,896</td>
<td>64,075</td>
</tr>
<tr>
<td>Applied Science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rendering of services</td>
<td>57,376</td>
<td>59,042</td>
</tr>
<tr>
<td>Sale of goods</td>
<td>4,036</td>
<td>3,071</td>
</tr>
<tr>
<td>Dividends</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Gain on sale from property, plant, and equipment</td>
<td>64</td>
<td>69</td>
</tr>
<tr>
<td>Total revenue and other gains</td>
<td>130,373</td>
<td>126,259</td>
</tr>
</tbody>
</table>

2. Operating expenses

### Employee benefits

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined contribution plans</td>
<td>2,725</td>
<td>2,753</td>
</tr>
<tr>
<td>Termination benefits</td>
<td>–</td>
<td>31</td>
</tr>
<tr>
<td>Other employee benefits</td>
<td>60,748</td>
<td>57,591</td>
</tr>
<tr>
<td>Total employee benefit expense</td>
<td>63,473</td>
<td>60,375</td>
</tr>
</tbody>
</table>

### Other Expenses

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials and supplies</td>
<td>10,489</td>
<td>11,682</td>
</tr>
<tr>
<td>Research collaboration</td>
<td>14,671</td>
<td>11,958</td>
</tr>
<tr>
<td>Property occupancy costs</td>
<td>5,870</td>
<td>5,758</td>
</tr>
<tr>
<td>Information technology</td>
<td>4,860</td>
<td>4,717</td>
</tr>
<tr>
<td>Remuneration of directors</td>
<td>297</td>
<td>297</td>
</tr>
<tr>
<td>Foreign currency (gain) loss</td>
<td>(38)</td>
<td>144</td>
</tr>
<tr>
<td>Movement within doubtful debt provision</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>Bad debts written off</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Change in the fair value of derivatives</td>
<td>(36)</td>
<td>(13)</td>
</tr>
<tr>
<td>Other expenses</td>
<td>10,742</td>
<td>9,137</td>
</tr>
<tr>
<td>Total other expenses</td>
<td>46,880</td>
<td>43,709</td>
</tr>
</tbody>
</table>

### Auditor’s remuneration

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditor’s remuneration comprises:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audit of the financial statements</td>
<td>177</td>
<td>183</td>
</tr>
<tr>
<td>Other assurance services (ACC audit)</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Total auditor’s remuneration</td>
<td>180</td>
<td>187</td>
</tr>
</tbody>
</table>
3. 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

<table>
<thead>
<tr>
<th>Remuneration</th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary accrual</td>
<td>1,583</td>
<td>1,002</td>
</tr>
<tr>
<td>Annual leave</td>
<td>5,202</td>
<td>4,999</td>
</tr>
<tr>
<td>Training leave</td>
<td>252</td>
<td>222</td>
</tr>
<tr>
<td>Long service leave</td>
<td>1,028</td>
<td>1,009</td>
</tr>
<tr>
<td>Retirement leave</td>
<td>418</td>
<td>436</td>
</tr>
<tr>
<td><strong>Total employee entitlements</strong></td>
<td>8,483</td>
<td>7,668</td>
</tr>
</tbody>
</table>

Comprising:

<table>
<thead>
<tr>
<th>Category</th>
<th>Current</th>
<th>Non-current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>7,482</td>
<td>6,666</td>
</tr>
<tr>
<td>Non-current</td>
<td>1,001</td>
<td>1,012</td>
</tr>
</tbody>
</table>

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.

4. 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:

<table>
<thead>
<tr>
<th>Category</th>
<th>Useful life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings and leasehold improvements</td>
<td>5–40 years</td>
</tr>
<tr>
<td>Vessels</td>
<td>20–31 years</td>
</tr>
<tr>
<td>Plant and equipment</td>
<td>8–10 years</td>
</tr>
<tr>
<td>IT equipment</td>
<td>3–8 years</td>
</tr>
<tr>
<td>Office equipment</td>
<td>5 years</td>
</tr>
<tr>
<td>Furniture and fittings</td>
<td>10 years</td>
</tr>
<tr>
<td>Motor vehicles</td>
<td>6 years</td>
</tr>
<tr>
<td>Small boats</td>
<td>10 years</td>
</tr>
</tbody>
</table>

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

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.
<table>
<thead>
<tr>
<th></th>
<th>Land</th>
<th>Buildings &amp; leasehold improvements</th>
<th>Vessels</th>
<th>Plant &amp; equipment</th>
<th>IT equipment</th>
<th>Office equipment</th>
<th>Furniture &amp; fittings</th>
<th>Motor vehicles</th>
<th>Small boats</th>
<th>Work in progress</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance at 1 July 2015</td>
<td>15,635</td>
<td>51,512</td>
<td>40,005</td>
<td>94,401</td>
<td>8,829</td>
<td>2,251</td>
<td>2,213</td>
<td>4,100</td>
<td>3,077</td>
<td>911</td>
<td>249,967</td>
</tr>
<tr>
<td>Additions</td>
<td>–</td>
<td>526</td>
<td>1,766</td>
<td>5,285</td>
<td>994</td>
<td>559</td>
<td>78</td>
<td>549</td>
<td>202</td>
<td>2,248</td>
<td>12,207</td>
</tr>
<tr>
<td>Transfers</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>911</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>(911)</td>
<td>–</td>
</tr>
<tr>
<td>Disposals</td>
<td>–</td>
<td>(1,227)</td>
<td>(237)</td>
<td>(19,007)</td>
<td>(6,323)</td>
<td>(2,712)</td>
<td>(1,091)</td>
<td>(251)</td>
<td>(122)</td>
<td>–</td>
<td>(31,015)</td>
</tr>
<tr>
<td>Foreign currency</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>(3)</td>
<td>(12)</td>
<td>(2)</td>
<td>(4)</td>
<td>(3)</td>
<td>–</td>
<td>–</td>
<td>(24)</td>
</tr>
<tr>
<td><strong>Balance at 30 June 2016</strong></td>
<td>15,635</td>
<td>50,766</td>
<td>41,532</td>
<td>84,613</td>
<td>21,260</td>
<td>6,348</td>
<td>1,255</td>
<td>4,321</td>
<td>3,157</td>
<td>2,248</td>
<td>231,135</td>
</tr>
<tr>
<td><strong>Accumulated depreciation and impairment lossess</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance at 1 July 2015</td>
<td>–</td>
<td>26,522</td>
<td>18,125</td>
<td>68,635</td>
<td>21,214</td>
<td>7,536</td>
<td>2,113</td>
<td>3,047</td>
<td>1,903</td>
<td>–</td>
<td>149,096</td>
</tr>
<tr>
<td>Depreciation change</td>
<td>–</td>
<td>2,321</td>
<td>2,599</td>
<td>6,020</td>
<td>2,206</td>
<td>363</td>
<td>41</td>
<td>346</td>
<td>110</td>
<td>–</td>
<td>14,006</td>
</tr>
<tr>
<td>Impairment</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Disposals</td>
<td>–</td>
<td>(1,227)</td>
<td>(182)</td>
<td>(18,845)</td>
<td>(6,308)</td>
<td>(2,687)</td>
<td>(1,090)</td>
<td>(251)</td>
<td>(121)</td>
<td>–</td>
<td>(30,711)</td>
</tr>
<tr>
<td>Foreign currency</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>(7)</td>
<td>(24)</td>
<td>(2)</td>
<td>(2)</td>
<td>(2)</td>
<td>–</td>
<td>–</td>
<td>(37)</td>
</tr>
<tr>
<td><strong>Balance as at 30 June 2016</strong></td>
<td>–</td>
<td>27,616</td>
<td>20,542</td>
<td>56,800</td>
<td>17,086</td>
<td>5,210</td>
<td>1,062</td>
<td>3,140</td>
<td>1,892</td>
<td>–</td>
<td>132,263</td>
</tr>
<tr>
<td><strong>Net book value at 30 June 2016</strong></td>
<td>15,635</td>
<td>23,150</td>
<td>20,990</td>
<td>28,810</td>
<td>4,172</td>
<td>1,138</td>
<td>193</td>
<td>1,181</td>
<td>1,265</td>
<td>2,248</td>
<td>96,782</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Land</th>
<th>Buildings &amp; leasehold improvements</th>
<th>Vessels</th>
<th>Plant &amp; equipment</th>
<th>IT equipment</th>
<th>Office equipment</th>
<th>Furniture &amp; fittings</th>
<th>Motor vehicles</th>
<th>Small boats</th>
<th>Work in progress</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance at 1 July 2014</td>
<td>12,450</td>
<td>50,473</td>
<td>40,183</td>
<td>94,401</td>
<td>8,829</td>
<td>2,251</td>
<td>2,213</td>
<td>4,100</td>
<td>3,073</td>
<td>2,779</td>
<td>245,157</td>
</tr>
<tr>
<td>Additions</td>
<td>3,185</td>
<td>1,075</td>
<td>–</td>
<td>6,853</td>
<td>1,648</td>
<td>448</td>
<td>32</td>
<td>303</td>
<td>78</td>
<td>911</td>
<td>14,533</td>
</tr>
<tr>
<td>Transfers</td>
<td>–</td>
<td>–</td>
<td>1,113</td>
<td>1,666</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>(2,279)</td>
<td>–</td>
</tr>
<tr>
<td>Disposals</td>
<td>–</td>
<td>(36)</td>
<td>(1293)</td>
<td>(5,493)</td>
<td>(1,665)</td>
<td>(777)</td>
<td>(14)</td>
<td>(377)</td>
<td>(74)</td>
<td>–</td>
<td>(9,729)</td>
</tr>
<tr>
<td>Foreign currency</td>
<td>–</td>
<td>–</td>
<td>3</td>
<td>3</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>6</td>
</tr>
<tr>
<td><strong>Balance at 30 June 2015</strong></td>
<td>15,635</td>
<td>51,512</td>
<td>40,003</td>
<td>97,427</td>
<td>26,601</td>
<td>8,503</td>
<td>2,272</td>
<td>4,026</td>
<td>3,077</td>
<td>911</td>
<td>249,967</td>
</tr>
<tr>
<td><strong>Accumulated depreciation and impairment lossess</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance at 1 July 2014</td>
<td>–</td>
<td>24,114</td>
<td>17,193</td>
<td>68,674</td>
<td>20,092</td>
<td>7,954</td>
<td>2,065</td>
<td>3,076</td>
<td>1,842</td>
<td>–</td>
<td>145,030</td>
</tr>
<tr>
<td>Depreciation charge</td>
<td>–</td>
<td>2,322</td>
<td>2,216</td>
<td>5,408</td>
<td>2,778</td>
<td>339</td>
<td>37</td>
<td>330</td>
<td>134</td>
<td>–</td>
<td>13,564</td>
</tr>
<tr>
<td>Impairment</td>
<td>–</td>
<td>120</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>120</td>
</tr>
<tr>
<td>Disposals</td>
<td>–</td>
<td>(34)</td>
<td>(1,284)</td>
<td>(5,447)</td>
<td>(1,657)</td>
<td>(777)</td>
<td>(14)</td>
<td>(360)</td>
<td>(73)</td>
<td>–</td>
<td>(9,646)</td>
</tr>
<tr>
<td>Foreign currency</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>20</td>
<td>5</td>
<td>1</td>
<td>–</td>
<td>27</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Balance as at 30 June 2015</strong></td>
<td>–</td>
<td>26,522</td>
<td>18,125</td>
<td>68,635</td>
<td>21,214</td>
<td>7,536</td>
<td>2,113</td>
<td>3,047</td>
<td>1,903</td>
<td>–</td>
<td>149,095</td>
</tr>
<tr>
<td><strong>Net book value at 30 June 2015</strong></td>
<td>15,635</td>
<td>24,990</td>
<td>21,878</td>
<td>28,792</td>
<td>5,387</td>
<td>967</td>
<td>159</td>
<td>979</td>
<td>1,174</td>
<td>911</td>
<td>100,672</td>
</tr>
</tbody>
</table>
5. 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:

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

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.

6. Identifiable intangibles

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.

<table>
<thead>
<tr>
<th>Category</th>
<th>Useful life</th>
<th>Cost in thousands of New Zealand dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copyrights</td>
<td>5 years</td>
<td>Software: 7,905, Copyrights: 215</td>
</tr>
<tr>
<td>Development costs</td>
<td>5 years</td>
<td>Software: 1,119, Copyrights: 4</td>
</tr>
<tr>
<td>Software</td>
<td>3 years</td>
<td>Software: 9,020, Copyrights: 215, Disposals: (2,149)</td>
</tr>
</tbody>
</table>

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

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.

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost in thousands of New Zealand dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copyrights</td>
<td>Balance as at 1 July 2015: 7,905, Additions: 1,119, Disposals: (2,149)</td>
</tr>
<tr>
<td>Development costs</td>
<td>Balance as at 1 July 2015: 6,717, Amortisation: 694, Disposals: (5)</td>
</tr>
<tr>
<td>Software</td>
<td>Balance as at 1 July 2015: 7,406, Additions: 694, Disposals: (5)</td>
</tr>
</tbody>
</table>

Net book value at 30 June 2016: Software 1,184, Copyrights 215, Total 1,215

<table>
<thead>
<tr>
<th>Category</th>
<th>Accumulated amortisation and impairment losses in thousands of New Zealand dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copyrights</td>
<td>Balance as at 1 July 2015: 7,905, Additions: 1,119, Disposals: (2,149)</td>
</tr>
<tr>
<td>Development costs</td>
<td>Balance as at 1 July 2015: 6,717, Amortisation: 694, Disposals: (5)</td>
</tr>
<tr>
<td>Software</td>
<td>Balance as at 1 July 2015: 7,406, Additions: 694, Disposals: (5)</td>
</tr>
</tbody>
</table>

Net book value at 30 June 2015: Software 1,614, Copyrights 215, Total 1,649
7. 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.

<table>
<thead>
<tr>
<th>in thousands of New Zealand dollars</th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade receivables</td>
<td>17,735</td>
<td>13,925</td>
</tr>
<tr>
<td>Sundry receivables</td>
<td>62</td>
<td>41</td>
</tr>
<tr>
<td>Provision for doubtful debts</td>
<td>(26)</td>
<td>(2)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17,771</strong></td>
<td><strong>13,964</strong></td>
</tr>
<tr>
<td>Classified as:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>17,771</td>
<td>13,964</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17,771</strong></td>
<td><strong>13,964</strong></td>
</tr>
</tbody>
</table>

Included in the Group’s trade receivables balance at the end of the year is one Crown debtor’s balance which equates to 31% of the Group’s total trade receivables balance (2015: 34%). 98% of the debtor’s balance is less than 60 days over due and is deemed to be low credit risk (2015: 94%).

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 month, calculated daily, on all invoices remaining unpaid at the due date.

Included in the Group’s trade receivable balance are debtors with a carrying amount of $223k (2015: $458k) 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.

Included in the provision for doubtful debts are individually identified debts totalling $26k (2015: $2k) 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.

8. 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.

<table>
<thead>
<tr>
<th>in thousands of New Zealand dollars</th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumables</td>
<td>370</td>
<td>356</td>
</tr>
<tr>
<td>Raw materials</td>
<td>296</td>
<td>364</td>
</tr>
<tr>
<td>Finished goods</td>
<td>1,349</td>
<td>1,206</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,015</strong></td>
<td><strong>1,926</strong></td>
</tr>
</tbody>
</table>

9. 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:

<table>
<thead>
<tr>
<th>in thousands of New Zealand dollars</th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Income tax expense</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current tax</td>
<td>2,084</td>
<td>2,215</td>
</tr>
<tr>
<td>Deferred tax relating to temporary differences</td>
<td>(603)</td>
<td>35</td>
</tr>
<tr>
<td><strong>Income tax expense</strong></td>
<td><strong>1,481</strong></td>
<td><strong>2,250</strong></td>
</tr>
</tbody>
</table>

Reconciliation of income tax expense

<table>
<thead>
<tr>
<th>in thousands of New Zealand dollars</th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Profit before income tax</strong></td>
<td>5,492</td>
<td>8,005</td>
</tr>
<tr>
<td>Tax at current rate of 28%</td>
<td>1,538</td>
<td>2,241</td>
</tr>
<tr>
<td>Adjustments to taxation:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other non-deductible expenses</td>
<td>48</td>
<td>28</td>
</tr>
<tr>
<td>R&amp;D tax concession</td>
<td>(91)</td>
<td>(28)</td>
</tr>
<tr>
<td>(Over)/under provision in previous year</td>
<td>(14)</td>
<td>9</td>
</tr>
<tr>
<td><strong>Income taxation expense</strong></td>
<td><strong>1,481</strong></td>
<td><strong>2,250</strong></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>in thousands of New Zealand dollars</th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit for the period</td>
<td>4,011</td>
<td>5,755</td>
</tr>
<tr>
<td>Add/(less) Items classified as investing activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net loss/(gain) on disposal of property, plant and equipment</td>
<td>232</td>
<td>(2)</td>
</tr>
<tr>
<td>Add/(less) non-cash items</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation and impairment</td>
<td>14,006</td>
<td>13,684</td>
</tr>
<tr>
<td>Amortisation of identifiable intangibles</td>
<td>813</td>
<td>694</td>
</tr>
<tr>
<td>Net foreign currency (gain)/loss</td>
<td>327</td>
<td>331</td>
</tr>
<tr>
<td>Increase/(decrease) in deferred tax liability</td>
<td>(603)</td>
<td>35</td>
</tr>
</tbody>
</table>

| Add/(less) movements in working capital items | | |
| Increase/(decrease) in payables and accruals and revenue in advance | 7,514 | (2,365) |
| Increase/(decrease) in employee entitlements | 814 | (1,499) |
| (Increase)/decrease in receivables and prepayments | (3,783) | 1,605 |
| (Increase)/decrease in inventory and uninvoiced receivables | (217) | (377) |
| (Increase)/decrease in taxation receivable | (102) | (1,065) |
| Increase/(decrease) in forward exchange derivatives | 49 | (40) |

| Net cash flows from operating activities | 23,061 | 16,736 |

12. 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.

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

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

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

All subsidiaries have a balance date of 30 June.
No stake in any subsidiary was acquired or disposed of during the year.

13. 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 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:

<table>
<thead>
<tr>
<th>in thousands of New Zealand dollars</th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term benefits</td>
<td>7,159</td>
<td>6,542</td>
</tr>
</tbody>
</table>

The table above includes remuneration of the Chief Executive and all key management positions. The increase from the 2015 year includes the effect of an increase in key science management positions.

14. Financial Instruments and Risk Management
The classification of financial assets and liabilities depends on the purpose for which the financial assets and liabilities were incurred. Management determines the classification of the Group’s financial assets and liabilities at initial recognition.

Financial assets
Financial assets are classified on initial recognition into the following categories: at fair value through profit or loss and loans and receivables.

Financial assets and liabilities at fair value through profit or loss - 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. 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.

Loans and receivables
Loans and receivables are non-derivative financial assets with 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 using the effective interest method.

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.

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 fair value through profit or loss where the liability is either held for trading or it is designated as 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 fair value through profit or loss upon recognition if it meets similar criteria as financial assets designated as 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 the following requirements imposed upon it 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 14 subsection financing facilities) is subject to two covenants:

1. That the value of the Group’s net tangible assets is greater than $50 million; 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 carrying value of all financial instruments is considered to approximate fair value.

All of the Group’s financial instruments are classified as being within level 2 of the fair value hierarchy as defined by NZ IFRS 13 Fair Value Measurement. Their fair value is determined with reference to quoted rates for identical instruments on active markets.

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, un invoiced 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 other than with the New Zealand Government which the Group does not consider to represent a material credit risk.

The exposure to the Group to credit risk as at 30 June 2016 was $43,164k (total exposure to credit risk, comprising cash and cash equivalents $20,328k, un invoiced receivables $5,065k, and receivables net of provisions $17,771k) (2015: $28,764k).

Further analysis on the trade receivables balance can be found in note 7.

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:

<table>
<thead>
<tr>
<th>Region</th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Zealand</td>
<td>41,156</td>
<td>26,682</td>
</tr>
<tr>
<td>Australia</td>
<td>971</td>
<td>1,284</td>
</tr>
<tr>
<td>USA</td>
<td>587</td>
<td>386</td>
</tr>
<tr>
<td>Other Asia Pacific countries</td>
<td>368</td>
<td>209</td>
</tr>
<tr>
<td>Other regions</td>
<td>108</td>
<td>205</td>
</tr>
<tr>
<td>Provision for doubtful debts</td>
<td>(26)</td>
<td>(2)</td>
</tr>
<tr>
<td><strong>Total credit risk</strong></td>
<td><strong>43,164</strong></td>
<td><strong>28,764</strong></td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Investment Type</th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash (on call)</td>
<td>2.25% - 3.0%</td>
<td>3.25% - 3.5%</td>
</tr>
</tbody>
</table>

The directors do not consider there is any significant exposure to 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 $36k (2015: $13k).

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

<table>
<thead>
<tr>
<th>in thousands of New Zealand dollars</th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash balances</td>
<td>211</td>
<td>2</td>
</tr>
<tr>
<td>Trade receivables</td>
<td>709</td>
<td>14</td>
</tr>
<tr>
<td>Trade payables</td>
<td>(185)</td>
<td>(23)</td>
</tr>
<tr>
<td>Statement of financial position exposure</td>
<td>735</td>
<td>(7)</td>
</tr>
</tbody>
</table>

NIWA has a regularly reviewed treasury management 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.

Payables and accruals of $9.576m (2015: $8.070m) having a maturity of less than one year are the Group’s contractual maturity. This is based upon the earliest date on which the Group can be required to pay.

Financing facilities
The Group has access to financing facilities made available by ANZ Bank with a total value of $10.5 million (2015: $10.5 million). This was undrawn at 30 June 2016 (2015: also undrawn). 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 (2015: $10.5 million).

15. Leases
Lessees 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).

<table>
<thead>
<tr>
<th>in thousands of New Zealand dollars</th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lease expense recognised in the year</td>
<td>2,213</td>
<td>2,201</td>
</tr>
<tr>
<td>Obligations payable after balance date on non-cancellable operating leases:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within 1 year</td>
<td>2,692</td>
<td>2,535</td>
</tr>
<tr>
<td>Between 1 and 2 years</td>
<td>1,912</td>
<td>2,073</td>
</tr>
<tr>
<td>Between 2 and 5 years</td>
<td>4,210</td>
<td>5,227</td>
</tr>
<tr>
<td>Over 5 years</td>
<td>2,819</td>
<td>3,470</td>
</tr>
<tr>
<td>Total obligations payable</td>
<td>11,533</td>
<td>13,305</td>
</tr>
</tbody>
</table>

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.

16. Capital commitments

<table>
<thead>
<tr>
<th>in thousands of New Zealand dollars</th>
<th>2016</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commitments for future capital expenditure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contracted, but not provided for</td>
<td>590</td>
<td>146</td>
</tr>
</tbody>
</table>

17. Contingent liabilities
There are no material contingent liabilities (2015: Nil).

18. Subsequent events
There are no subsequent events. (2015: Nil).
Preparation disclosures

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.


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

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 2016 and the comparative information for the year ended 30 June 2015.

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 (IFRSs).

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.

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.

Adoption of new and revised standards
Certain new accounting standards and interpretations have been published that are not mandatory for 30 June 2016 reporting periods and have not been early adopted by the Group.

The key terms applicable to the Group are:

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. 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. 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 1 July 2018 and has yet to assess its full impact.

NZ IFRS 15: Revenue from contracts with customers (effective for annual periods beginning on or after 1 January 2019)

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 2018 and earlier application is permitted.

The Group intends to adopt NZ IFRS 15 on 1 July 2018 and has yet to assess its full impact.

NZ IFRS 16: Leases (effective for annual periods beginning on or after 1 January 2019)

NZ IFRS 16 replaces the current guidance in NZ IAS 17. Under NZ IFRS 16, a contract is, or contains, a lease if the contract conveys the right to control the use of an identified asset for a period of time in exchange for consideration. Under NZ IAS 17, a lessee was required to make a distinction between a finance lease (on balance sheet) and an operating lease (off balance sheet). NZ IFRS 16 now requires a lessee to recognise a lease liability reflecting future lease payments and a ‘right-of-use asset’ for virtually all lease contracts. Included is an optional exemption for certain short-term leases and leases of low-value assets; however, this exemption can only be applied by lessees. The standard is effective for accounting periods beginning on or after 1 January 2019. Early adoption is permitted but only in conjunction with NZ IFRS 15, ‘Revenue from Contracts with Customers.

The Group intends to adopt NZ IFRS 16 on 1 July 2019 and has yet to assess its full impact.

There are no other standards that are not yet effective and that would be expected to have a material impact on the Group.
Corporate governance and disclosures

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.

<table>
<thead>
<tr>
<th>Director</th>
<th>Board meetings</th>
<th>Special Board meetings</th>
<th>Board strategy day</th>
<th>ARLC Committee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sir Christopher Mace, KNZM (Chairman)</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>4*</td>
</tr>
<tr>
<td>Nicholas Main (Deputy Chairman)</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Dr Helen Anderson</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Prof Keith Hunter</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>Prof Gillian Lewis</td>
<td>11</td>
<td>–</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>Michael Pohio</td>
<td>8</td>
<td>–</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Jason Shoebridge</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

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

Directors’ remuneration

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

<table>
<thead>
<tr>
<th>Director</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sir Christopher Mace, KNZM (Chairman)</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>Craig Ellison (Deputy Chairman)*</td>
<td>–</td>
<td>45</td>
</tr>
<tr>
<td>Nicholas Main (Deputy Chairman)</td>
<td>45</td>
<td>36</td>
</tr>
<tr>
<td>Dr Helen Anderson</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Prof Keith Hunter</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Prof Gillian Lewis</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Michael Pohio</td>
<td>36</td>
<td>–</td>
</tr>
<tr>
<td>Jason Shoebridge</td>
<td>36</td>
<td>36</td>
</tr>
</tbody>
</table>

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

Subsidiary company directors

The following people held office as directors of NIWA’s subsidiary companies at 30 June 2016:

<table>
<thead>
<tr>
<th>Subsidiary Company</th>
<th>Directors</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIWA Vessel Management Ltd</td>
<td>C Mace, N Main, H Anderson, K Hunter, G Lewis, M Pohio, J Shoebridge</td>
</tr>
<tr>
<td>Unidata Pty Ltd</td>
<td>B Cooper1, B Biggs1, D Saunders2</td>
</tr>
<tr>
<td>EcoConnect Ltd</td>
<td>J Morgan1, P Baker1</td>
</tr>
<tr>
<td>NIWA Australia Pty Ltd</td>
<td>C Mace, N Main, H Anderson, K Hunter, G Lewis, M Pohio, J Shoebridge</td>
</tr>
<tr>
<td>NIWA Environmental Research Institute</td>
<td>C Mace, N Main, H Anderson, K Hunter, G Lewis, M Pohio, J Shoebridge</td>
</tr>
<tr>
<td>NIWA Natural Solutions Ltd</td>
<td>J Morgan1, P Baker1</td>
</tr>
</tbody>
</table>

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, ensure that they will generally incur no monetary loss as a result of lawful actions undertaken by them as directors or employees. These 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 Karen Shires of PricewaterhouseCoopers to conduct the audit on her behalf. Their audit remuneration and fees paid for other services are detailed in note 2.

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 in the minutes of Board meetings. A register containing all relevant interests 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 remuneration exceeded $100,000 during the year, stated in brackets of $10,000, was:

<table>
<thead>
<tr>
<th>Remuneration Range</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>100,000–109,999</td>
<td>49</td>
</tr>
<tr>
<td>110,000–119,999</td>
<td>48</td>
</tr>
<tr>
<td>120,000–129,999</td>
<td>19</td>
</tr>
<tr>
<td>130,000–139,999</td>
<td>19</td>
</tr>
<tr>
<td>140,000–149,999</td>
<td>13</td>
</tr>
<tr>
<td>150,000–159,999</td>
<td>10</td>
</tr>
<tr>
<td>160,000–169,999</td>
<td>7</td>
</tr>
<tr>
<td>170,000–179,999</td>
<td>6</td>
</tr>
<tr>
<td>180,000–189,999</td>
<td>9</td>
</tr>
<tr>
<td>190,000–199,999</td>
<td>3</td>
</tr>
<tr>
<td>200,000–209,999</td>
<td>2</td>
</tr>
<tr>
<td>210,000–219,999</td>
<td>1</td>
</tr>
<tr>
<td>240,000–249,999</td>
<td>1</td>
</tr>
<tr>
<td>300,000–309,999</td>
<td>1</td>
</tr>
<tr>
<td>320,000–329,999</td>
<td>3</td>
</tr>
<tr>
<td>620,000–629,999</td>
<td>1</td>
</tr>
</tbody>
</table>

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 115 Science, 19 Science Support, 30 Management, and 28 Subsidiary staff. (2015: 98 Science, 17 Science Support, 28 Management, and 23 Subsidiary staff).

In 2016, the Group did not make any payments for compensation or other benefits in respect of the cessation of employment of employees (2015: $31,245).

Donations
Donations of $5,749 were made during the year (2015: $2,357).
AUDITOR’S REPORT

Independent Auditor’s Report

To the Readers of National Institute of Water and Atmospheric Research Limited financial statements for the year ended 30 June 2016

The Auditor-General is the auditor of National Institute of Water and Atmospheric Research Limited (the Group). The Auditor-General has appointed me, Karen Shires, 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, on her behalf.

Opinion

We have audited the financial statements of the Group on pages 101 to 117, that comprise the statement of financial position as at 30 June 2016, the statement of comprehensive income, statement of changes in equity and statement of cash flows for the year ended on that date and the notes to the financial statements that include accounting policies and other explanatory information.

In our opinion, the financial statements of the Group:
- present fairly, in all material respects:
  - its financial position as at 30 June 2016; and
  - its financial performance and cash flows for the year then ended; and
- comply with generally accepted accounting practice in New Zealand in accordance with NZ equivalents to International Financial Reporting Standards (NZ IFRS).

Our audit was completed on 16 August 2016. This is the date at which our opinion is expressed.

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

Basis of opinion

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

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

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

An audit also involves evaluating:
- the appropriateness of accounting policies used and whether they have been consistently applied;
- the reasonableness of the significant accounting estimates and judgements made by the Board of Directors;
- the adequacy of the disclosures in the financial statements; and
- the overall presentation of the financial statements.

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

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

Responsibilities of the Board of Directors

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


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

Responsibilities of the Auditor

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

Independence

When carrying out the audit, we followed the independence requirements of the Auditor-General, which incorporate the independence requirements of the External Reporting Board.

In addition to the audit, we have carried out an ACC Partnership Program Review engagement, which is compatible with those independence requirements. Other than this, we have no relationship with or interests in the Group.

Karen Shires
PricewaterhouseCoopers
On behalf of the Auditor-General
Auckland, New Zealand
## Directors
- Sir Christopher Mace, KNZM, Chairman
- Nicholas Main, Deputy Chairman
- Dr. Helen Anderson
- Prof. Keith Hunter
- Prof. Gillian Lewis
- Michael Pohio
- Jason Shoebridge

## Executive Team
- John Morgan, Chief Executive
- Geoff Baird, General Manager, Communications and Marketing
- Patrick Baker, Chief Financial Officer
- 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

## Auditor
- Karen Shires with the assistance of PricewaterhouseCoopers on behalf of the Auditor-General

## Bankers
- ANZ Bank of New Zealand Ltd

## Solicitors
- Atkins Holm Majurey

## Insurance broker
- Marsh Ltd

## Head office
- 41 Market Place
- Auckland Central 1010
- Private Bag 99 940
- Newmarket 1149, Auckland
- New Zealand

- Tel: +64 9 375 2050
- Fax: +64 9 375 2051

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- [google.com/+niwanz](http://google.com/+niwanz)
- [linkedin.com/company/niwa](http://linkedin.com/company/niwa)
- [www.niwa.co.nz](http://www.niwa.co.nz)