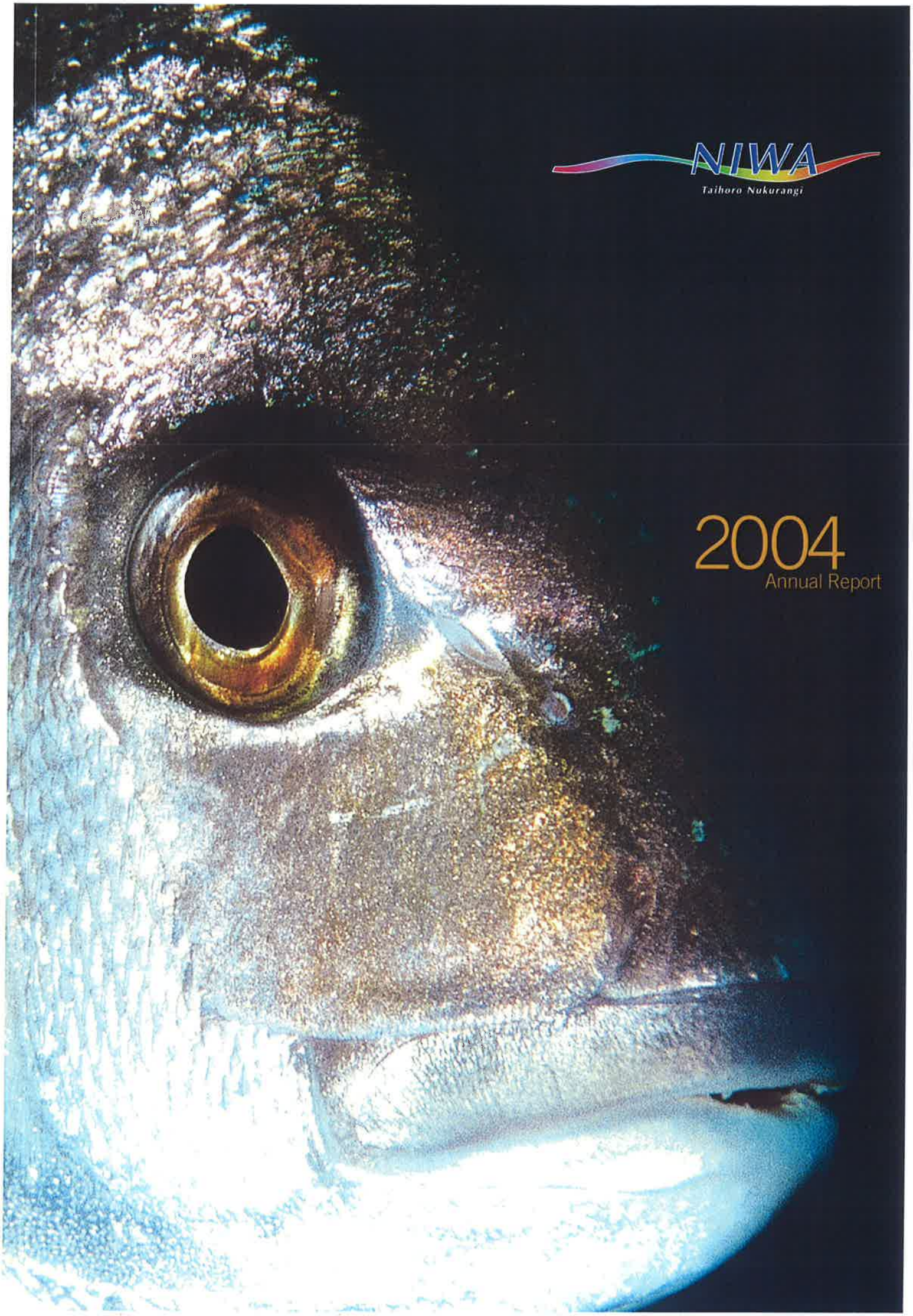

NIWA
Taihoro Nukurangi
2004
Annual Report

Contents

Cover: Snapper (tāmure), Pagrus auratus, one of New Zealand's most important commercial and recreational fish species.

2004 Annual Report of the National Institute of Water & Atmospheric Research Ltd

NIWA
Taihoro Nukurangi

great science, great services, great staff

Financial summary

	2004 $'000	2003 $'000	2002 $'000	2001 $'000	2000 $'000
Revenue	**84,631**	84,200	81,312	77,113	71,556
– Public Good Science	**39,591**	39,780	37,869	37,359	37,010
– Ministry of Fisheries	**14,602**	16,705	16,260	13,701	11,343
– Commercial	**30,438**	27,715	27,183	26,053	23,203
Operating surplus before tax	**7,036**	7,216	7,465	7,328	8,001
Net surplus	**5,276**	4,726	4,730	4,717	5,326
Capital expenditure	**8,839**	9,064	10,173	8,586	7,448
Return on average equity (%)	**10.7**	10.6	9.6	8.7	10.9

Chair's report

For the year to 30 June 2004, NIWA achieved a group operating surplus before tax of $7.0 million, against $7.2 million in the previous year. Net surplus after tax was $5.3 million ($4.7 million in 2002–03). Gross revenue from research, consulting, vessel operations, and all other business activities was $84.6 million ($84.2 million in 2002–03). Shareholders' funds at 30 June 2004 stood at $51.9 million ($46.7 million in 2002–03). NIWA's after-tax return on average shareholders' equity was 10.7%. A total of $1.1 million was allocated to NIWA's ongoing staff profit-share scheme before arriving at the surplus before tax.

NIWA has a proud history of providing excellent science and services whilst achieving strong financial results and high staff morale. In 2003–04, we continued this tradition with one of our best financial performances and an outstanding year of scientific achievement. Both results were attributable to strong leadership, great commitment from staff, rapid response to opportunities and changes in the marketplace, excellent teamwork inside NIWA and with other organisations, and a desire to help New Zealand fulfil its economic, environmental, and social goals.

Our record revenue of $84.6 million came principally from research (47%), consulting (37%), and fisheries stock assessment (14%) contracts, all of which were acquired on a contestable basis. The year-end result of $5.3 million net surplus after tax reflects many hard decisions made within NIWA over the last two years to make ourselves as lean and competitive as possible.

NIWA, however, must continue to evolve if it is to stay successful. Our aim is to develop a portfolio of companies and partnerships that efficiently and effectively utilise all the knowledge, tools, products, and services we create. In 2003–04, we took three significant steps in this direction. We established companies to commercialise our intellectual property and deliver real-time environmental forecasts, and we invested in a company that manufactures environmental monitoring equipment. These companies, when coupled with our research and consulting services, our vessel company, and our companies in Australia and the USA, provide an exciting base for future development. In 2004–05, we look forward to developing appropriate governance and management frameworks to ensure this new portfolio of companies develops well.

A key area of focus in 2003–04 was to secure a more sustainable future for our research vessel *Tangaroa*. Whilst the vessel is an essential component of NIWA's oceanographic research, it also plays a significant role in the development of New Zealand's Exclusive Economic Zone. During 2003–04, NIWA worked closely with the Crown to develop a seven-year outlook for *Tangaroa* which will efficiently and effectively meet our nation's needs.

Key issues currently facing NIWA include the need to reward staff well (and hence retain them) and to maintain critical mass. Many of our core science areas have lost considerable research time over the last five years, and maintaining these capabilities (and associated morale and productivity) is an increasing challenge. Non-Specific Output Funds (NSOF) play an important role in maintaining and fostering essential research capabilities and in developing new opportunities for growth. Without NSOF, we would struggle to be an innovative research and development company, and synergies between the different entities of the NIWA Group would be greatly reduced.

Subsequent to year-end the Board agreed to pay a dividend of $15 million, reflecting the sound structure and strong financial performance of the company.

I would like to thank the Executive and the Board for the superb commitment they have to the company.

Sue Suckling

Sue Suckling
Chair

Chief Executive's report

The 2003–04 financial year was a demanding, but highly successful, one for NIWA. Significant change was required to move forward and grow the organisation. In addition to maintaining existing science momentum, new research areas needed to be developed. Solutions had to be found for replacing or maintaining several key large assets. Our core services had to be extended to extract all we could from the knowledge and tools we create. New businesses and partnerships needed to be established to increase our emphasis on product sales and the commercialisation of intellectual property. To incur this much change and still perform well was a credit to our staff, management team, and Board, and reinforced our desire to remain a highly innovative and successful research organisation based on a platform of 'Great Science, Great Services, and Great Staff'.

Over the last year, considerable emphasis has been placed on improving access to NIWA's science, services, and products. During 2003–04, staff from NIWA gave over 500 presentations, were involved in 248 media releases, and wrote more than 1400 scientific papers and reports. Our achievements were also communicated through the regular production of eight different newsletters, each targeted to meet the needs of specific stakeholder groups. Our website had more than 16.4 million pages viewed. We serviced more than 10 600 requests for information from our nationally significant public-good databases. Our six National Centres not only extended the quality and range of our services, but also markedly increased the number of individuals and organisations we interact with.

Our relationships with other organisations have also grown in number and strength, both to produce excellent science and to support New Zealand's economic, environmental, and social aspirations. Strong teams developed by NIWA and the Institute of Geological & Nuclear Sciences have helped to extend the boundaries of New Zealand's continental shelf, and to improve community response to natural hazards. Our work with the energy sector has helped to assess new initiatives, identify and quantify sources of renewable energy, and introduce appropriate technology to remote communities. In collaboration with the primary production sector, we have helped to quantify the abundance of fish stocks, worked with horticulturalists to determine where best to plant selected crops, and assisted the dairy and aquaculture industries in finding ways to optimise production whilst minimising environmental concerns. We have supplied juvenile paua, kingfish, and salmon for ongrowing by industry, and we are actively working with industry to develop new broodstock. We have isolated promising anti-inflammatory compounds, nutraceuticals, probiotic organisms, and biocontrol agents from a wide range of marine and freshwater organisms.

Our work with Government departments has helped to develop important national databases for biodiversity and biosecurity information, to predict the spread of undesirable pests such as the Asian gypsy moth and the fall webworm, and to create novel habitat and environmental classification systems for improved resource management. Through active and positive relationships with regional and local authorities we have been able to help them plan how their communities will grow and to make best use of their land, water, and climate. Our work with the Cancer Society has increased awareness of the harmful effects of UV radiation. We have assisted in school education programmes, created novel UV index displays at public swimming pools, provided detailed information for the Cancer Society's 'Sunsmart' webpage, and supplied daily UV updates for Telecom's WAP phones.

In collaboration with Ngāti Kurauia, we are developing novel skin care products based on traditional knowledge of rongoa associated with puia and ngawha at Tokaanu Hot Springs. We are also assisting iwi through our Māori research and development unit, Te Kūwaha, to develop improved wastewater systems that address Māori cultural and spiritual values, establish new aquaculture businesses, and improve energy efficiency within communities and assess the potential for developing renewable energy sources. Over the last four years, Te Kūwaha has grown from 2 to 14 researchers and has now established itself as a significant force in promoting and fostering Māori development.

Whilst NIWA has always had many strong international relationships, our impact around the world is growing. Fisheries scientists from NIWA have completed reviews of stock assessments of yellowtail snapper in the southeast of the USA, orange roughy in Chile, and southern bluefin tuna in Australia. We have assisted in acoustic surveys of hake in southern Chile and blue whiting off the west coast of Ireland. We have helped to upgrade the hydrometric network of Negara Brunei, assisted the Cook Islands in the management of their oyster industry, advised on waste treatment along the Coral Coast of Fiji, participated as technical advisors in biosecurity surveys in Vietnam, and improved measurement of greenhouse gases in the South Pacific. We have also played a major role in running training programmes for the Pacific region. During 2003–04, training courses were conducted for hydrologists and climatologists from the Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Niue, Papua New Guinea, Solomon Islands, Rarotonga, Tonga, and Vanuatu. *The Island Climate Update*, a monthly newsletter produced by NIWA in collaboration with 10 other organisations from around the globe, completed its 46th issue, and continues to provide much needed information on climatic events in the Pacific region.

Throughout the year, we have made major advances in all of our core science areas. For example, we have created a novel methane sensor for measuring emissions from ruminant animals, developed a highly sophisticated fisheries population model that is eagerly sought by resource managers and researchers worldwide, enhanced the volume and taste of kina roe, improved forecast systems for floods, storm surge, and tsunami, and conducted a major survey of marine biodiversity in the Ross Sea region of Antarctica. This annual report outlines many of our major achievements in science during 2003–04.

Perhaps a lesser known aspect of NIWA is our dedication to education. During 2003–04, more than 1600 students from schools in Auckland, Waikato, Bay of Plenty, Wellington, and Nelson participated in Regional Science Fairs sponsored by NIWA. More than 37 000 primary and intermediate age children visited the NIWA Discovery Room at Kelly Tarlton's Underwater World. NIWA staff supervised 68 postgraduate

Actual performance versus Statement of Corporate Intent (SCI)

Years ended 30 June	Actual 2004 $'000	SCI 2004 $'000	Actual 2003 $'000
Revenue	84,631	85,068	84,200
Operating expenses and depreciation	77,746	80,864	76,811
Operating surplus before tax	7,036	4,208	7,216
Net surplus	5,276	2,877	4,726
Average total assets	69,480	64,784	64,838
Average shareholders' funds	49,296	49,403	44,414
Profitability			
Operating surplus (%)	8.0	4.9	8.6
Return on average equity after tax (%)	10.7	5.8	10.6
Return on assets (EBIT/average total assets) (%)	9.8	6.5	11.2
Liquidity and efficiency			
Current ratio	1.4	1.5	1.1
Quick ratio	1.8	2.1	1.6
Financial leverage			
Debt to average equity (%)	41	24	45
Gearing (%)	1	–	1
Proprietorship (%)	71	76	68

Dollars in thousands.

students across six universities. We sponsored 15 postdoctoral fellows. Thirteen training courses were run to assist in the professional development of staff in regional councils, Government departments, and consultancy firms.

We have also made considerable advances in operating in a sustainable manner. NIWA is a member of the New Zealand Business Council for Sustainable Development and has taken Sustainable Development Reporting seriously. We have worked hard to meet all commitments to date and have set ambitious targets for the future. Our report this year has been verified by an independent auditing firm.

As for the future, NIWA is evolving rapidly. During 2003–04, three major initiatives were undertaken to enable NIWA to expand the nature of its core business. A wholly owned subsidiary, NIWA Natural Solutions Ltd, was established to commercialise products and technologies developed by NIWA. A new joint venture company, EcoConnect Ltd, was formed with the United Kingdom Met Office to deliver real-time environmental forecasts. This initiative was greatly enhanced by the upgrade of our Cray T3E high performance computing facility from 144 processors, 20 GB of main memory, and 600 GB of high performance disk storage to 544 processors, 120 GB of main memory, and 1200 GB of high performance disk storage. This upgrade allows NIWA to pursue its environmental forecasting objectives and meet all internal high performance computing demands for the next four years. Lastly, an 80% shareholding was taken in an Australian instrument manufacturing company, Unidata Pty Ltd, which specialises in the creation of new technologies for environmental monitoring and real-time decision support networks. This company complements a similar service provided by NIWA in New Zealand. These three businesses, coupled with NIWA's traditional strength in research, consultancy, and vessel management, provide a strong platform for sustainable growth, create new opportunities to sell a diverse range of products and services, and allow us to promote ourselves and share risks with others. In 2004–05, the key challenge for NIWA will be to manage this portfolio of companies well.

In closing, I would like to thank our Board, staff, collaborators, and stakeholders for their valuable contributions throughout the year. Our achievements during 2003–04 have set a strong platform for a bright and exciting future.

Rick Pridmore
Chief Executive

NIWA Executive

NIWA Executive: (left to right) Don Robertson, Charlotte Severne, Bryce Cooper, Dene Biddlecombe, Rick Pridmore, Rob Murdoch, Murray Poulter, Mark James, Neil Andrew. Inset: John McKoy, Clive Howard-Williams.

Rick Pridmore, *Chief Executive Officer*

Rick became Chief Executive Officer of NIWA in August 2002 after having served as Deputy Chief Executive (Strategic Development) and Research Director of NIWA. Born in the USA, Rick came to New Zealand in 1976. He completed his PhD at the University of Otago in 1980, and from 1980 to 1993 he worked as a Government scientist, specialising in marine and freshwater ecology.

Bryce Cooper, *Director, Strategic Development*

Bryce has a PhD in microbiology and is a graduate of the London Business School Senior Executive Programme. He has held research leader and Regional Manager roles in NIWA, and is currently responsible for overseeing NIWA's strategic initiatives, including commercialisation of research, NIWA Australia, and partnerships with Māori, Government agencies, and industry.

Mark James, *Director, Operations*

Mark completed his PhD in aquatic ecology at the University of Otago, and has spent 20 years as a scientist specialising in lake and coastal ecology research and consulting. In 2000 he moved from Christchurch to Hamilton to take up the position of Regional Manager, NIWA Hamilton, and he was appointed as NIWA's Director of Operations in September 2002.

Rob Murdoch, *Director, Research*

Rob has a PhD in marine science from the University of Otago and has specialist interests in oceanography and marine ecology. He held the positions of research leader and Regional Manager at NIWA in Wellington before taking on roles overseeing NIWA's strategic research and NIWA Vessel Management Ltd.

Dene Biddlecombe, *Chief Financial Officer & Company Secretary*

Dene is a chartered accountant with an MBA from the University of Otago, majoring in marketing and corporate strategy. As well as holding a number of company secretary and treasurer roles within NIWA, Dene is Chair of the Institute of Chartered Accountants of New Zealand (ICANZ) Public Sector Committee.

Neil Andrew, *General Manager, Marine & Aquaculture*

Neil holds a BSc and MSc (Hons) from the University of Auckland and a PhD from the University of Sydney. His research background is in fisheries science and marine ecology, particularly the relationships between subtidal ecology and related shellfish fisheries, such as paua and kina.

Clive Howard-Williams, *General Manager, Freshwater & Education*

Clive is an aquatic ecologist with a PhD from the University of London. He was a research scientist at the Max Planck Institute for Limnology, and has specialised in research on water quality, water plants, and wetlands. He has a wide interest in freshwater degradation and change, and in Antarctica. He is a Fellow of the Royal Society of New Zealand and an Adjunct Professor at the University of Canterbury.

John McKoy, *General Manager, Fisheries & Bioactives*

John is a marine zoologist with a PhD from Victoria University of Wellington. He has contributed in a range of roles to fisheries research in New Zealand since 1973, in MAF, MAF Fisheries, and, since 1995, NIWA. He has worked in crustacean and molluscan aquaculture and fisheries biology in New Zealand, Australia, and the Pacific.

Murray Poulter, *General Manager, Atmosphere*

Murray graduated from the University of Canterbury and then worked in England and Germany on wave propagation in the atmosphere and space. He returned to New Zealand where he applied radar methods to determine the role of ocean waves in coastal and air-sea interaction processes, working in New Zealand, Canada, the USA, and Antarctica, before taking on a management role in NIWA.

Don Robertson, *General Manager, Biodiversity, Biosecurity, & Information Services*

Don completed a PhD in marine biology at the University of Otago in 1973. He spent much of the last 30 years in marine fisheries research, particularly deepwater fisheries, and was a science manager for the last 15 years, and a Regional Manager in Wellington.

Charlotte Severne, *General Manager, Māori Development*

Ka pūwaha te tai nei, hoea tātou

Mauri ora ki a koutou katoa i runga i ngā āhuatanga o te wā. Ka tangi atu ki ō tātou tini mate, haere, whakangaro atu. Ki a tātou te hunga ora e takatū nei, ko te tūmanako i roto i ngā whakaaro, kei te piki te ora ki tēnā, ki tērā. Otirā kei te mihi kau ana te ngakau o Taihoronukurangi ki ngā iwi huri noa i te motu. Ko Charlotte Severne tōku ingoa. Ko ahau tētahi o ngā uri o Tūwharetoa me Tūhoe Potiki anō hoki. Heoi anō he Tumu Whakarae Māori tōku nei tūranga o roto o NIWA me Te Kūwaha. Ko te tino kaupapa matua o Te Kūwaha kia tautoko, kia āwhina ai ngā tūmanako, wawata o te iwi Māori e hāngai ana ki tō mātou nei kamupene. Nō reira, e ngā iwi tēnā hoki tātou katoa.

NIWA at a glance

NIWA is New Zealand's leading provider of environmental research and consultancy services.

Its science provides the basis for sustainable resource management, and its consultancy services help clients solve problems relating to the use and management of:

- Atmosphere & Climate
- Freshwater
- Coast & Oceans
- Biodiversity & Biosecurity
- Fisheries & Biotechnology
- Aquaculture

NIWA was established as a Crown Research Institute in 1992. It operates as a stand-alone company with its own board of directors and its shares held by the Crown. In its establishment year, the company had 329 staff, revenue of $35.5 million, and assets of $20 million. Twelve years later, these measures had largely doubled or trebled: NIWA now has 612 staff at 15 sites around New Zealand, revenue of about $85 million, and assets of more than $70 million.

The company now has subsidiaries in New Zealand, Australia, and the USA and a joint venture with the UK Met Office:

NIWA Vessel Management Ltd provides vessels for charter for scientific research;

NIWA Natural Solutions Ltd commercialises products and technologies developed by NIWA;

NIWA Australia Pty Ltd provides scientific research and consultancy services in Australia;

NIWA Environmental Research Institute and *NIWA (USA), Inc.* provide scientific research and consultancy in the USA;

Unidata Pty Ltd creates new technologies for environmental monitoring and real-time decision support networks; and

EcoConnect Ltd is a joint venture with the UK Met Office to deliver real-time environmental forecasts.

NIWA has a project-management-based structure which enables synergies from strong multidisciplinary research and the ability to work in large integrated teams and to shift resources to meet the client's requirements – the 'One NIWA' concept.

NIWA is a technology-driven innovative company in the business of creating wealth as well as providing advice for policy and management decisions. Its clients include New Zealand and overseas governments; local and regional councils; industries such as energy, fisheries, forestry, dairy, horticulture, and agriculture; port authorities and oil companies; consulting engineers; and others who use water and air for commercial and recreational purposes.

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'.

www.niwa.co.nz

Our aspirations

Our mission

NIWA is an internationally respected research organisation dedicated to creating and delivering innovative and unrivalled science-based services and products that enable people and businesses to make best use of the natural environment and its living resources, and derive benefit from them in a sustainable manner.

Our vision

NIWA will fulfil its mission by:

- maintaining and enhancing our national and international reputations for excellence in marine, freshwater, and atmospheric science;
- providing a sound scientific basis for the sustainable management and development of natural resources;
- producing new tools and services to enhance environmental management, improve business performance, and increase public safety;
- ensuring optimal value is obtained from all species harvested from, or reared in, marine and fresh waters;
- developing and commercialising new products to boost economic growth;
- securing a diverse portfolio of clients and partnerships to broaden our source of revenue, increasing our awareness of new commercial opportunities, and minimising the Crown's ownership risks;
- operating with financial efficiency to ensure that we generate the cash flow needed to develop our business and provide an appropriate return on shareholders' funds.

This vision is consistent with the Crown Research Institutes Act 1992, which requires all Crown Research Institutes to conduct scientific research for the benefit of New Zealand and to be financially viable.

Our values

In support of our mission and vision statements we are committed to:

- promoting creativity, innovation, and teamwork;
- ensuring our core science areas are appropriately staffed and supplied with sufficient equipment and resources to conduct leading-edge science and deliver innovative and unrivalled services and products;
- supporting Māori development and Māori research excellence;
- maintaining a culture which is adaptable and seeks opportunities;
- being recognised for our integrity, skill, and professionalism in conducting all aspects of the company's business;
- attracting, retaining, and rewarding high quality staff;
- providing a safe and healthy working environment;
- ensuring that all staff are treated in a fair and equitable manner and that their work and private lives are appropriately balanced;
- taking social responsibility and valuing our environment;
- encouraging stakeholder participation in the setting of our research and business strategies;
- working collaboratively with other organisations and people to form partnerships that add value;
- honouring the principles of the Treaty of Waitangi in all our endeavours.

Our core business

NIWA's research focus

Atmosphere & Climate

physical and chemical processes affecting the atmosphere and climate, including global effects, stratospheric research, and atmosphere-ocean interactions

- weather, flooding, and related hazards
- greenhouse gases, ozone, and atmospheric chemistry
- climate monitoring and prediction
- Pacific Island climate
- air quality and airborne biohazards
- renewable energy resources
- ocean climate
- Antarctic research
- environmental monitoring networks
- satellite remote sensing
- databases and software

Freshwater

chemistry, physics, and biology of lakes, rivers, and wetlands; the complex interactions influencing these ecosystems; and their response to environmental disturbances

- hydrology and hydraulics
- aquatic pollution control and prediction
- sediment dynamics
- biodiversity and biosecurity
- freshwater fish and fisheries
- lake and river restoration
- restoration of mahinga kai
- environmental classification
- aquatic plants and algal blooms
- floods and scour in rivers
- catchment modelling and pollution mitigation
- riparian management and aquatic restoration
- wetland ecosystems
- lake and river ecosystem models
- effects of land-use change in catchments
- national monitoring and databases – biodiversity and biosecurity, river flow, water quality, and sediment

Coasts & Oceans

geological, biological, and physical properties of oceans, coastal waters, estuaries, and harbours

- current, tide, and wave analysis and modelling
- ecological surveys and environmental assessments
- seafloor and habitat mapping, seismic surveys
- coastal erosion and marine sedimentary processes
- oceanography
- palaeoceanography
- ocean productivity and food chain processes
- biodiversity and biosecurity, taxonomy
- environmental classification
- marine invertebrate collection and databases
- seabird population biology and ecology
- biotechnology and marine natural products
- restoration of coastal and estuarine environments
- restoration of kai moana
- outfall dispersion and modelling

Fisheries

fisheries assessment and impacts

- fish abundance and productivity
- population modelling and risk analysis
- estimation of sustainable harvest levels
- fish biology and ecology
- fisheries interaction with biodiversity
- genetics and stock separation
- impact of fishing on non-target species
- assessment of highly migratory species
- assessment of non-commercial catches

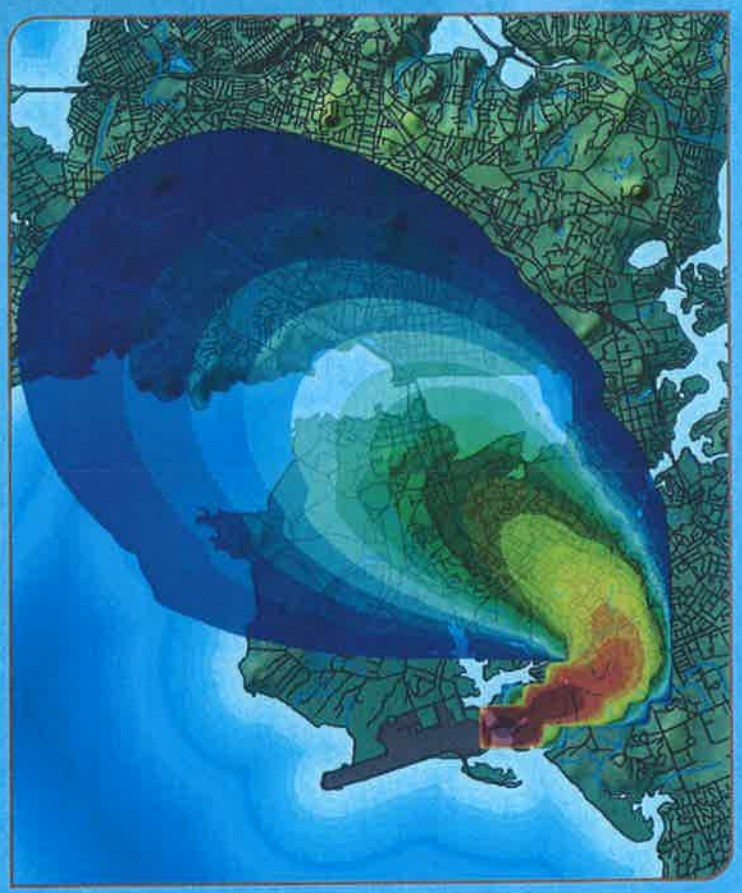
Aquaculture

breeding, early life history, growth and survival, hatchery technology, disease management, and stock enhancement – practical research for commercial development

- culture of eels, kina, kingfish, mussels, oysters, paua, rock lobsters, salmon, seahorses, seaweeds, snapper, and sponges
- research and technology for commercial application in partnership with industry
- recirculation technology
- ecological surveys and site selection, feasibility studies for new aquaculture ventures, water quality assessment and diagnosis
- sustainability of shellfish aquaculture
- salmon ova and smolt supply to industry
- genetic improvement and disease diagnosis
- hatchery training and troubleshooting
- disease management

The following pages show some of the highlights of NIWA's research and consultancy during 2003–04

Atmosphere & Climate



Simulated dispersion of an airborne pollutant from Auckland Airport.

Predicting the flight path of pests & diseases

It has been estimated that if foot-and-mouth disease broke out in the North Island, 15 000 to 20 000 jobs would be lost, GDP would drop by 4% in the first three months, and the Government would spend some $200 million controlling the outbreak and compensating farmers.

Foot-and-mouth is a highly contagious virus which can travel long distances by wind, and NIWA is on call to provide emergency response to the Ministry of Agriculture and Forestry (MAF) in the event of a foot-and-mouth outbreak.

NIWA has developed computer models to predict how wind-borne pests and diseases could spread. It's not a matter of simply knowing which way the wind is blowing. For instance, the red imported fire ant flies only in calm, warm, and humid conditions in the two days after significant rainfall. NIWA is continuing to upgrade the models to allow for different behaviour patterns, such as male moths flying upwind in search of a mate. Over the last year, NIWA scientists have worked out where several exotic insect pests first came into the country and where they had probably spread, helping MAF to better target its searches.

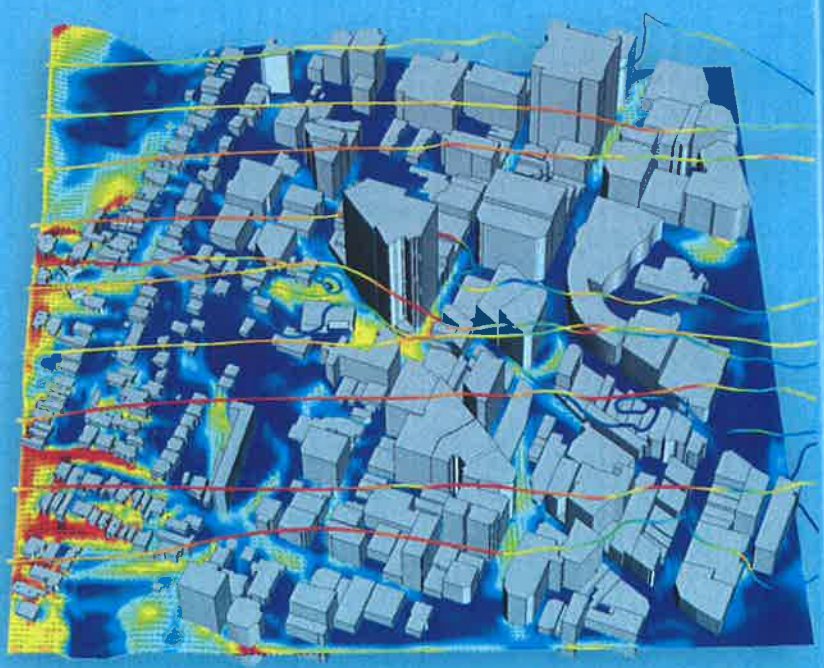
In the near future, real-time predictions developed on NIWA's upgraded supercomputer, running weather and pest dispersion models simultaneously, will greatly enhance the ability of managers to respond efficiently to outbreaks or incursions.

Hard maths helps planning for high winds

Strong winds can wreak havoc – on people's homes, commercial buildings, power lines, coastal infrastructure, and more – so accurate predictions of wind flows around buildings or across different landscapes can greatly help planners, designers, and engineers.

But modelling the flow of air (or anything else that flows, such as water, dust clouds, or even blood) is no mean feat. Some of the world's most powerful supercomputers were built to do such calculations.

NIWA has developed new mathematical methods to model wind and other so-called 'fluids' 10 to 100 times faster than older techniques. The new methods also better simulate the interface between two fluid flows, such as wind over water.



NIWA's 'virtual wind tunnel' can be used to evaluate wind hazards around proposed buildings or additions to existing buildings.

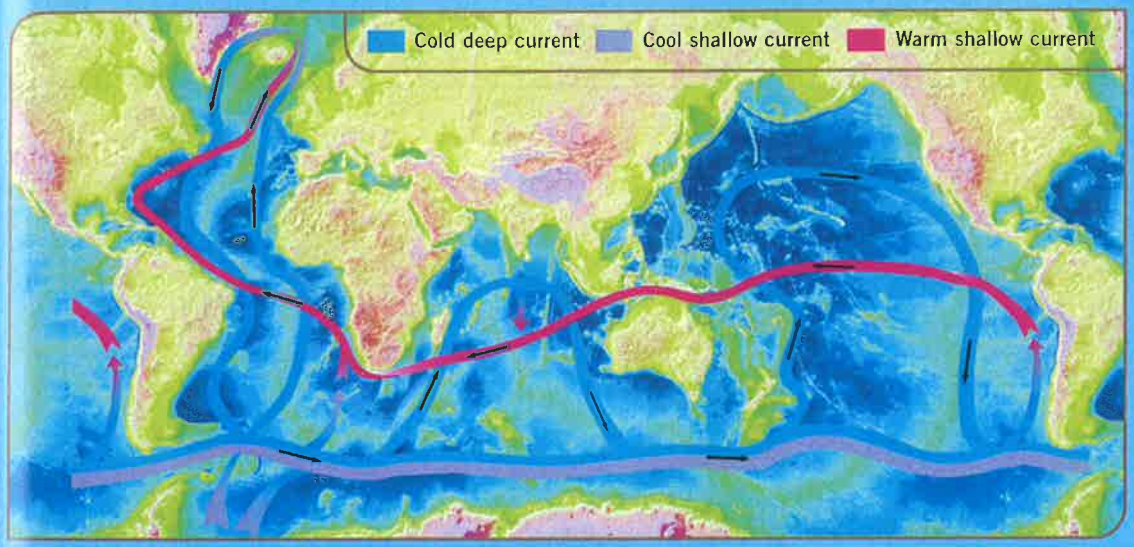
Could the 'ocean conveyor' collapse?

The Hollywood disaster movie *The Day After Tomorrow* depicts near-instant climate change brought on by the sudden breakdown in ocean circulation. How likely is this, and how would we be affected?

Water moves around the world's oceans as density changes. The cooler and saltier the water, the denser it is, and the more it sinks; warmer, fresher water rises. The global circulation system, driven mainly by these density differences, is often called the 'ocean conveyor', and it plays a big role in moderating the climate of Europe and eastern North America.

Some scientists suggest that global warming could shut off the cooling and sinking of seawater in the North Atlantic, which kick-starts the ocean conveyor, because that part of the ocean would receive too much freshwater from increased rainfall or melting glaciers.

The ocean conveyor is unlikely to fail abruptly this century, but if it did, New Zealand might in fact get slightly warmer. The last time the conveyor broke down, 12 800 years ago, the North Atlantic was plunged into a mini ice age, but maritime New Zealand barely cooled.



Relatively salty seawater in the North Atlantic cools and sinks, flowing south as a deep cold current to Antarctica. This cold, dense water eventually moves north into the Indian and Pacific Oceans, where it gradually warms, rises to the surface, then heads back to the North Atlantic.

Smart sunburn warnings

NIWA has worked with the Cancer Society to develop units which measure the intensity of sunburning ultraviolet radiation and display that information on the UV Index (UVI). The units continuously adjust the pointer on the index. This shows people their exposure to sunburning UV at that moment and is linked to advice about what precautions to take, depending on skin type.

A UVI less than 3 (coloured green) means low risk and no special precautions are needed. An index greater than 10 (coloured purple) is extreme, and skin damage can occur in less than 15 minutes. At midday in the height of summer, the index can exceed 13.

UV intensities are about 50% greater in New Zealand than in comparable latitudes in Europe, where the UVI rarely exceeds 8. That is due to our relatively clean air, lower ozone levels, and closer proximity to the sun in summer.

NIWA publishes daily forecasts of the UVI for New Zealand on its website: www.niwa.co.nz.

Laser radar beams probe the atmosphere above NIWA's research facility at Lauder, Central Otago.

Freshwater

Investigating cures for Rotorua's sick lakes

In the summer of 2002–03, the Rotorua Lakes hit a new crisis point as their water quality continued to deteriorate. Potentially toxic algal blooms turned Lake Rotoiti fluorescent green. Swimming, fishing, and boating had to be banned. The following summer saw yet more health warnings and restrictions on recreation.

One of the difficulties in cleaning up Lake Rotoiti is that about a quarter of its volume is displaced each year by nutrient-laden water coming through the Ohau Channel from neighbouring Lake Rotorua. NIWA and the University of Waikato have been advising Environment Bay of Plenty on how effective various engineering options would be at reducing or diverting this flow of poor quality water.

This is highly technical work, combining nutrient sampling and analysis with numerical modelling of the movement of water, waves, and sediment under different environmental conditions. For example, would a structure which holds back sediment in Lake Rotorua in a light breeze do the same when the wind blows more strongly? The work shows that the fate of water from Lake Rotorua depends heavily on the wind conditions and the water temperature. This poses big challenges. NIWA is continuing to advise Environment Bay of Plenty on the most effective ways to address the problem.

Real-time flood data

The February 2004 floods brought home the value of NIWA's national hydrometric network. The network measures water levels and flows in rivers and lakes, complementing the monitoring done by regional and district councils.

During the floods, NIWA provided regional councils and civil defence and emergency management teams with real-time information to help them respond to the rapidly changing situation. Since then, the data have been used to assess the severity of the floods.

NIWA's 14 field teams maintain the network at 300 locations around the country, including the Chatham Islands. Typically, water levels are recorded every 15 minutes. The flow of water down the rivers is estimated from this. Every hour, data are transmitted to the local field office and to NIWA's central hydrometric database in Christchurch, and on to clients. Field teams regularly measure the actual flow themselves to check the river flow estimates are accurate.

Evan Baddock uses an Acoustic Doppler Current Profiler to measure flow in the Clutha River. This new technology is flexible, safe, and cost-effective.

There are many other uses of the data, including hydropower plant operation, electricity market information, flood forecasting, resource consents, lake and river research, and investigating the effects of changes in land use and climate variability on river flow.

Tracing contamination of urban waterways

People leave a trail of chemical waste behind wherever they go. Vehicles drop zinc from tyres, copper from brake linings, and toxic and carcinogenic compounds from oil and exhaust smoke. Buildings slowly corrode, releasing zinc from galvanised roofs and paints and copper from plumbing, and we apply pesticides and herbicides to our gardens and lawns. When it rains, some of these chemicals are washed into the stormwater pipes that drain urban areas, and often end up in estuaries where they pose a threat to marine life.

Pete Pattinson checks equipment before entering Auckland City's wastewater network.

NIWA has produced a suite of models to trace contamination in estuaries and harbours back to its source.

Initial work, funded by FRST, produced a model to predict the amounts of chemicals washed off urban roads, based on the numbers of vehicles using the roads and the intensity of the rainfall.

More recently, NIWA extended this model for Metrowater and the Auckland City Council to predict the amounts of chemicals being washed off whole city catchments, depending on the mix of land use and the pattern of rainfall. For these same clients, in collaboration with the Auckland Regional Council, NIWA also built a model of the Waitemata Harbour that takes the predicted amounts of chemicals in stormwater and models how and where these chemicals will move in the harbour, allowing for tides, wind, and other factors.

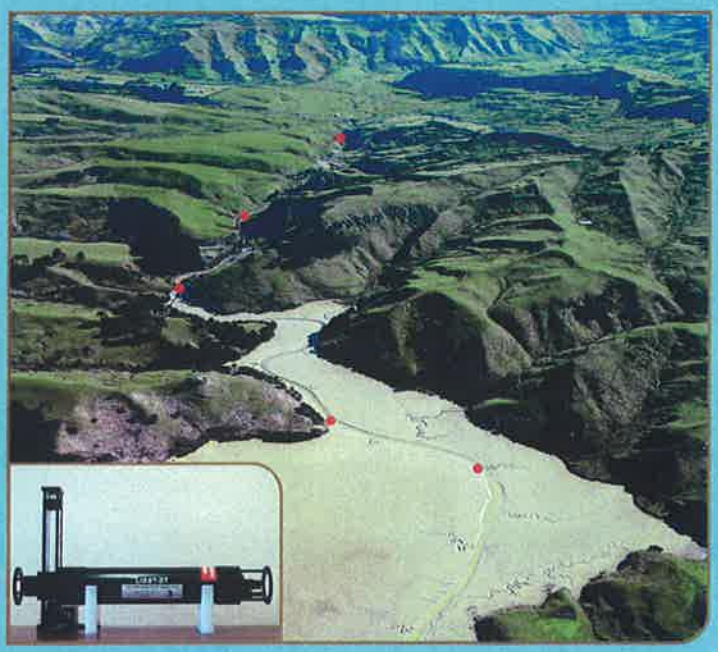
A heavy load – a new tool for studying sediment

When too much sediment ends up in streams and estuaries, it causes all sorts of problems. Shellfish, which feed by filtering water, die – their gills clogged by the particles. Lower light levels stunt aquatic plant growth. Bottom-dwelling creatures are smothered. Fine sediment causes sandy estuaries to become muddy, weakening the natural ecosystem and leaving it vulnerable to invasive species. Sediment also carries contaminants, such as heavy metals and disease-causing bacteria.

As part of research into the effects of sediment, NIWA is using a new submersible measuring device (called the LISST-ST) to study 'flocculation'. This is the process by which small sediment particles carried down freshwater streams and rivers coalesce to form larger particles when they enter saltier water in estuaries.

The formation of these larger particles determines how they move about and where they end up. Understanding flocculation, therefore, opens the way to better predictions of where and how fast sediment, including contaminants, will build up in rivers, lakes, and estuaries.

NIWA is using this knowledge to advise regional councils, central Government, and others on the likely effects of a wide range of resource uses, including plans to develop whole catchments, proposed locations for housing, and national policies regulating land use and discharge of sediment into waterways.



We used LISST-ST to measure flocculation in Whaingaroa Harbour (Raglan) at different locations (shown in red) to track changes sediment particles undergo as they move down the river into the salt water of the estuary.

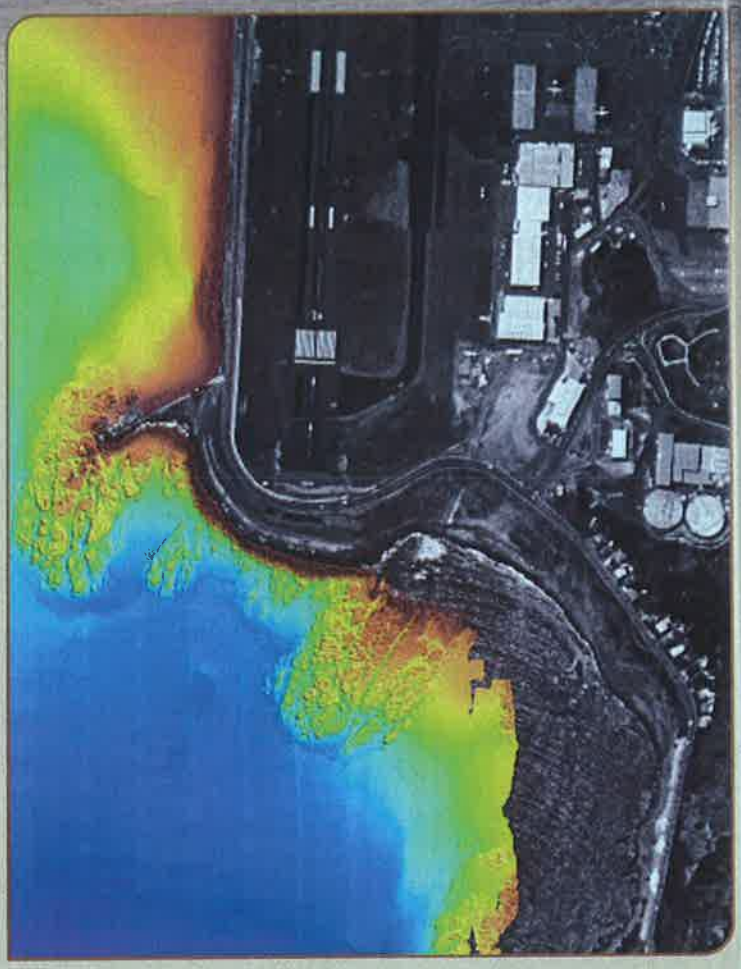
Coasts & Oceans

New mapping technology

Since fitting *Tangaroa* with multibeam sonar equipment in 2000, NIWA has been producing stunning images of the seafloor, but there's a limit to how close to the coast the system can be used. Now, NIWA has bought additional specialised equipment to map the seabed in shallow water. The Simrad EM3000D sends down 254 separate acoustic pulses at the same time, so it can map strips of the seafloor hundreds of metres wide to a resolution of tens of centimetres.

In just one hour's surveying off the South Wellington coast, NIWA gathered 2.5 million separate data points, producing detailed profiles of the seafloor which show rocky reefs, sand ripples, gravel waves, and man-made structures as clearly as if the water were stripped away and high resolution photographs taken from the air.

The system proved its worth during the latest voyage to the Ross Sea, Antarctica, and during surveys of gas pipelines in the Taranaki basin. With greater and more varied use of coastal waters for aquaculture, tourism, marine conservation, and engineering (to name a few), detailed maps of the seabed just off the coast will become increasingly important.

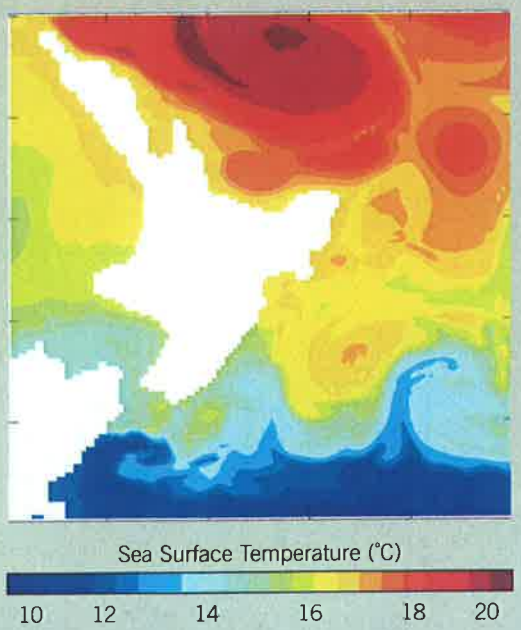


Seabed off the south end of Wellington Airport, as surveyed by EM3000D.

Now, here is the [ocean] weather ...

NIWA is poised to develop 'ocean weather forecasts' showing the likely changes in ocean currents and temperature in much the same way as the standard weather forecast does for the atmosphere.

From shallow coastal waters, the ocean around New Zealand plummets to depths of more than 6000 metres. Huge masses of water swirl and mix in patterns which rival those in the air. These ocean currents are carrying heat and nutrients, strongly influencing marine life and the climate.



The potential range of uses for ocean weather forecasts is vast, including pollution clean-up, maritime safety, and recreation.

NIWA scientists, with FRST funding, have also developed new techniques so computer models can include small eddies near the shore, giving a more accurate picture of the complex currents around New Zealand. NIWA is also combining marine biological models with ocean models to help quantify some of the factors determining how much organic matter will be produced by microscopic plants (phytoplankton) using sunlight. This organic matter is used directly or indirectly by all parts of the marine ecosystem, including commercial fish species, so it's important to know the likely impact changes in ocean conditions could have on its production.

How will the oceans handle climate change?

As humans continue to burn fossil fuels and intensify land use, the level of carbon dioxide (a greenhouse gas) in the atmosphere continues to rise.

Like all plants, microscopic ocean plants (phytoplankton) absorb some of this carbon dioxide when they photosynthesise, using sunlight to produce nutrients. But marine plants and animals also release carbon back into the atmosphere.

NIWA is involved in the global scientific quest to understand what happens to carbon in all its forms when it's in the ocean. This is important for predicting the future of the earth's climate, and for developing possible ways to reduce the effects of climate change.

In March-April 2004, 29 scientists from 17 research organisations in 6 countries participated in one of New Zealand's largest oceanographic research surveys, as part of the international SOLAS (Surface Ocean Lower Atmosphere Studies) programme. This particular study, called SAGE (SOLAS Air-Sea Gas Experiment), took *Tangaroa* to the windswept Southern Ocean where scientists added iron fertiliser to the water to increase the amount of carbon dioxide being used by phytoplankton. They then measured the physical, chemical, and biological effects.

This type of large, multidisciplinary study presents an organisational challenge, but is the way forward for the study of complex processes where air and sea meet. In the next couple of years, the results from SAGE and other experiments of its type will improve our ability to predict the likely consequences of human impacts on the environment.

Scott Nodder, with visiting Dutch scientist Gerard Duinevald, programming equipment to measure processes at the sea floor.

Tony Reiri deploys a Carioca surface drifter buoy off Tangaroa during SAGE.

Sometimes carbon sinks to the seafloor in the form of excreted material from marine organisms, or dead plants or animals. There it can get buried in sediment and is effectively locked up for hundreds to thousands of years.

NIWA has quantified for the first time how much organic matter from the surface waters around New Zealand sinks down and is used as food for organisms living on the seafloor. Technological advances mean it's now possible to measure deepsea processes without dragging sediment to the surface, subjecting the bottom-dwelling organisms to dramatic pressure and temperature changes. This work, funded by FRST, was done in collaboration with the Royal Netherlands Institute for Sea Research, and New Zealand universities.

Curiously, it seems there's not enough food sinking down to the organisms in both subtropical and subantarctic waters. It may be that they have evolved to handle long periods when they eat little or nothing, or it might be that their nutrient intake is supplemented by organic matter being swept in from the nearby continental margin by ocean currents.

Fisheries, Aquaculture, & Biotechnology

How climate affects fish stocks

The hoki catch off the west coast of the South Island has dropped significantly over the last few years, and it may be that the climate is partly to blame.

That is just one example of how understanding the impact of major shifts in the environment on the survival of larvae is important for managing New Zealand fisheries.

NIWA has found that hoki larvae have a better chance of surviving their first year of life in cool temperatures, westerly winds, and El Niño-like conditions (more westerlies in summer with a tendency to bring droughts in the east, and more southerlies in winter bringing cooler seas and lower air temperatures than normal).

Since 1997, warm water flowing into the Tasman Sea has raised the sea temperature by 0.5 °C. This is quite an extreme change, and may partly explain why fewer young hoki survived than would be expected even when there were El Niño conditions in some years (for example, in 2000).

In addition, New Zealand's climate goes through a cycle, the Interdecadal Pacific Oscillation, which lasts for several decades. Since the late 1970s, the country has mostly been in a 'positive' phase, with stronger westerly winds and more frequent El Niño events. But now we may be entering a 'negative' phase, with weaker westerly winds and fewer El Niño events. Such shifts in the climate lead to changes in the distribution of plants and animals in the ocean, the diet of marine organisms, and the chances that larvae will survive. NIWA is modelling the links between climate and fish abundance to help improve predictions of commercial fish stocks.

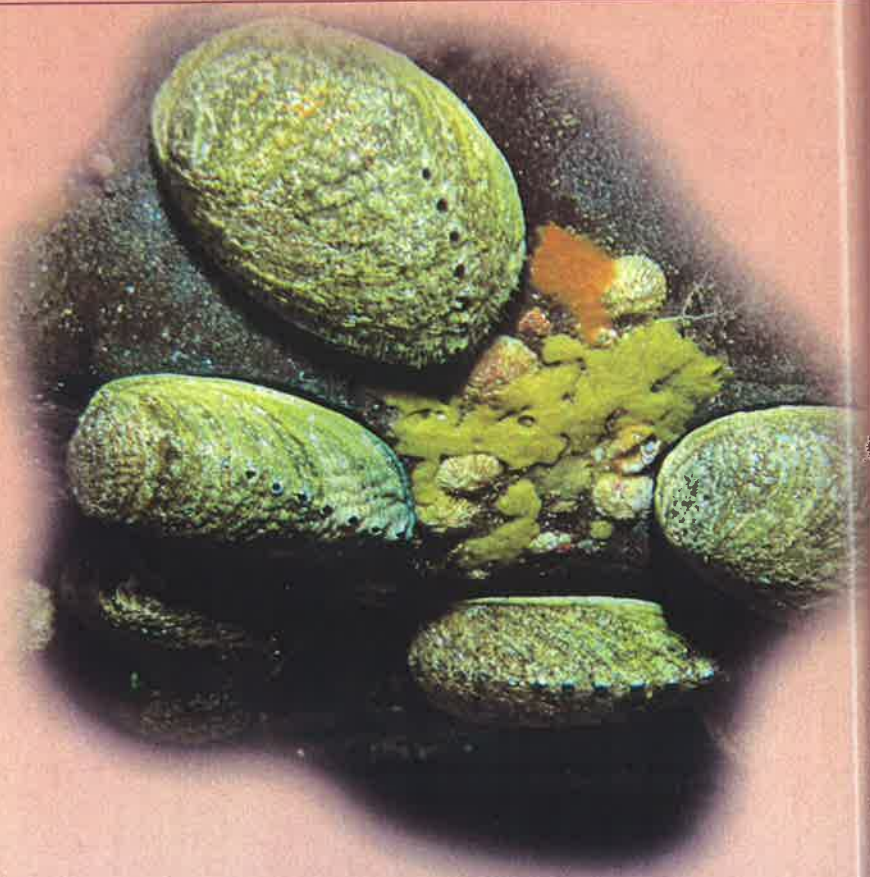
Time-saving method to check shellfish growth

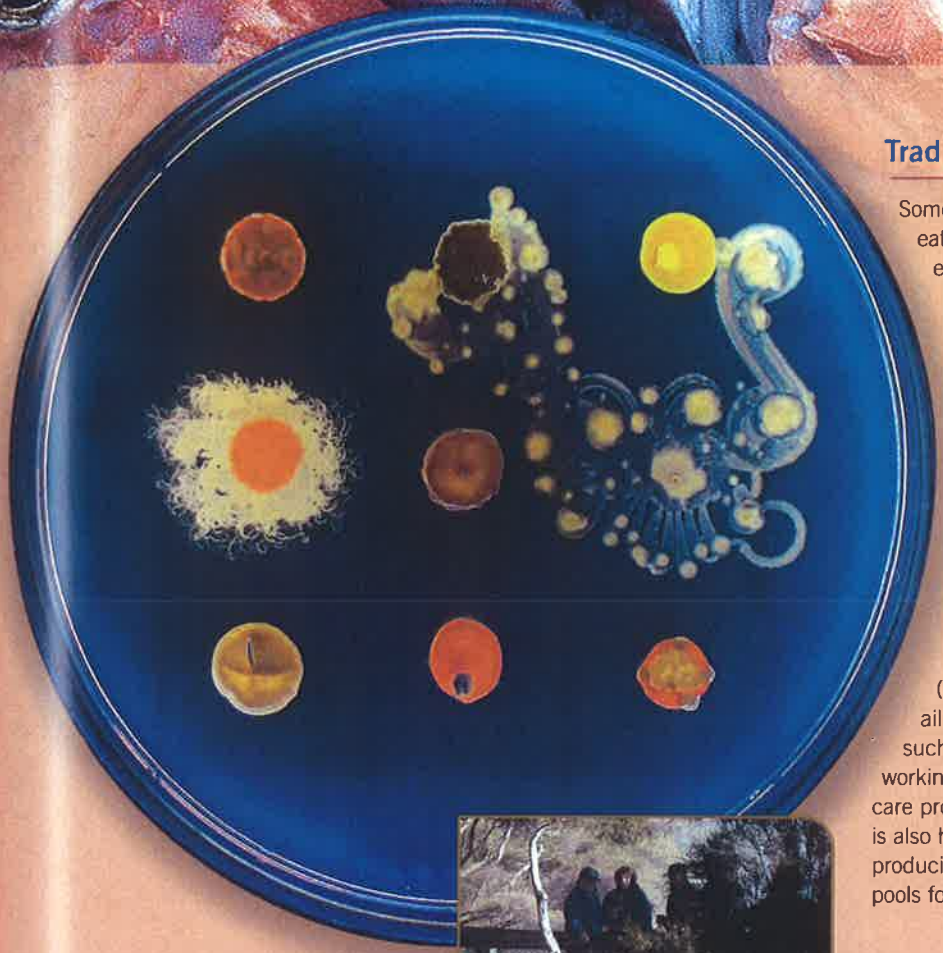
Understanding the growth and reproductive patterns of shellfish is vital for assessing the sustainability of those fisheries. Until now, however, it's only been possible to monitor the age and growth of shellfish by measuring and tagging them, then attempting to recapture the tagged animals to check how much they've grown.

This method is costly and time-consuming. Tagging requires two diving trips to get just one snapshot of how fast the shellfish are growing. Typically, only a small proportion of the original sample can be found later, so hundreds of shellfish in any given area have to be tagged. This is a particular problem in remote areas prone to bad weather.

NIWA is developing a new way of checking the growth of paua – analysing elements of the shell. Stable isotopes in the shell reflect changes in temperature and saltiness of the water the paua live in. By matching this profile with how the climate in an area has varied, the scientists can estimate the growth rate of the paua.

It is likely that this method could be applied to a range of shellfish species.





Traditional knowledge goes high tech

Sometimes nature has the answers. When people eat 'live' yoghurt to fight some infections, they're encouraging the growth of friendly bacteria (probiotics) to ward off harmful ones.

Probiotics is a fast rising niche market in human health. Harmful bacteria can develop resistance to antibiotics, but not to probiotics, and there is less consumer wariness about using probiotics. NIWA has carried out research into the use of probiotics to ameliorate disease in marine aquaculture facilities, and is now doing commercial trials.

For generations, Ngāti Kurauia have used certain puia (geothermal pools) at Tokaanu (near Taupo) to alleviate the symptoms of skin ailments such as leprosy and joint problems such as arthritis and rheumatic diseases. NIWA is working with Ngāti Kurauia to produce a line of skin care products based on traditional knowledge. NIWA is also helping them develop low cost ways of producing balneotherapy (bath) salts from the hot pools for the home spa market.

Vicky Webb sharing knowledge with Ngāti Kurauia at Tokaanu.

Farming eels

Although New Zealand has the third largest wild eel fishery, there is limited scope for expansion in the short term, and the future clearly lies in aquaculture. Recent advances made by NIWA at its Bream Bay Aquaculture Park mean that commercially viable shortfinned eel production may not be many years away.

Young migratory eels, known as 'glass eels', are captured as they arrive from their remote birthplace at sea to settle in rivers and streams. Weaning glass eels on to artificial diets from their previous live food has proved challenging, but NIWA is getting high feeding rates and low mortality among shortfinned eels, which appear to be a better prospect for aquaculture than longfinned eels.

NIWA uses its state-of-the-art recirculating production unit at Bream Bay for experiments on eel production. Here the viability of eels as an aquaculture species is being assessed under commercial conditions. Factors such as feed conversion, growth, and mortality rates are being investigated.

Antarctica

Heading north in Antarctica – how life changes

In February 2004, five NIWA marine ecologists spent a month on the Italian Antarctic research vessel *Italica*.

The voyage included scientists from several different countries with expertise in a range of disciplines, including processes in the atmosphere and the water, physiological adaptations of fish, invertebrate ecology, and seafloor habitats.

They travelled along the section of the western Ross Sea coast known as Victoria Land – north of the site of NIWA's previous work on the seafloor in McMurdo Sound. The study focused on the ways the coastal environment changed according to the latitude, and attempted to relate these changes to differences in the plants and animals living near the shore.

It seems that a number of environmental variables, including currents, sea ice, icebergs, and water temperature, have important effects on the ecology of the seabed at different latitudes. Icebergs scouring the bottom, for example, appear to be a major factor in the north of the region.

The research was funded by the Ministry of Fisheries and undertaken in collaboration with the Italian Antarctic Research Programme.

Seaweeds in Antarctic waters

Antarctic marine macroalgae (seaweeds) are specially adapted to grow not only in very low light, but also at water temperatures below zero. At Cape Evans, on Ross Island, at more than latitude 77° S only three types of seaweed can survive. They are all red algae, which are efficient at using very low light, yet despite their adaptation to the extreme conditions some can take decades to grow just a few tens of centimetres long.

Thanks to the *Italica* research voyage, NIWA scientists were able to study coastal locations further north in the Ross Dependency. At Cape Hallett, they found the largest Antarctic seaweed *Himantothallus grandifolius*, which can grow up to more than 10 metres long. This brown seaweed grows there, but not further south, partly because more light is available over the course of a year.

NIWA's research focuses on how the seaweeds make use of the few months of the year when there is enough light for growth. They seem to have an extraordinary ability to use low light, to maximise photosynthesis when the light is stronger, and to survive the long winter darkness. This ability determines where the different types of seaweed can grow and how they contribute to Antarctic coastal ecosystems.

NIWA's contribution to the *Italica* voyage was funded by the Ministry of Fisheries, and FRST funds NIWA's ongoing research into Antarctic seaweeds.

Oases of life on the world's driest continent

The 1500 square kilometres of the McMurdo Ice Shelf, near Scott Base, contain thousands of water bodies, ranging from large puddles to small lakes. This is the centre of NIWA's research on Antarctic pond ecosystems, in collaboration with the Cawthron Institute and the universities of Auckland and Canterbury.

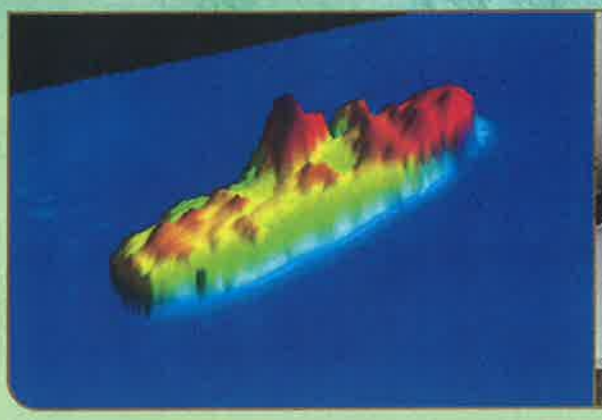
The surface of the ice shelf here is covered with rocks and gravel which absorb sunlight and so enhance the melting of ice, feeding a network of ponds and small streams. During the brief summer melt they support complex and diverse ecosystems. These rich, microbial communities bear a striking resemblance to fossils of the earliest forms of life on Earth.

NIWA is investigating how the extreme climate affects the physical and chemical structure of the ponds and the organisms the ponds support – in particular to help understand vulnerability to climate change.

The research is funded by FRST with support from Antarctica New Zealand.

Research vessels

Uncovering the seabed



The minesweeper *South Seas* sank off Point Halswell in Wellington Harbour in 1942 after colliding with an inter-island ferry. The wreck is a favoured dive spot, but the low visibility meant that nobody had seen a decent image of the whole vessel. That all changed earlier this year when NIWA used its new multibeam acoustic technology to produce the first images of the entire wreck on the seabed in stunning detail.

NIWA bought the Simrad EM3000D multibeam echosounder for use in shallow water to complement its existing Simrad EM300 system for deeper water.

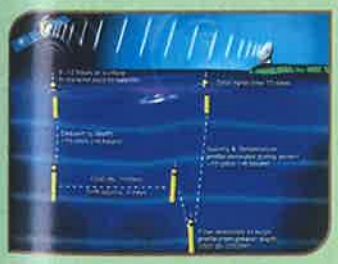
The EM3000D covers the seabed from the shore to a water depth of about 150 metres at very high resolution. It can be fitted underneath both research vessels *Tangaroa* and *Kaharoa*, as well as the survey launch *Pelorus*, and it produces 254 separate acoustic beams that can map strips of the seafloor hundreds of metres wide.

The system's capabilities were graphically illustrated when it was used to chart the shallow coastal waters at both ends of the Wellington Airport runway [see page 14].

Floats across the Pacific

NIWA research vessels are making a major contribution to the international Argo programme by deploying high-tech floats in the South Pacific and Southern Oceans.

Argo aims to maintain an array of 3000 floats in the world's oceans, which corresponds to an approximate spacing between floats of 300 kilometres. *Kaharoa* and *Tangaroa* have been contracted by the University of Washington (Seattle) and the Scripps Institution of Oceanography (San Diego) to conduct four extensive Argo deployment voyages to fill gaps in the network of floats.



Kaharoa – which usually works in coastal waters – successfully completed the first of these voyages in February and March 2004, deploying 61 Argo floats en route to Chile and back.

The floats provide real-time information on the temperature and salt content of the upper ocean, as well as currents, and the information will have many uses, including: improved seasonal climate forecasts, measuring global warming, and predicting the strength of tropical cyclones.

Biodiversity among the icebergs

Conditions were severe at times during *Tangaroa*'s most recent voyage to the Ross Sea, in Antarctica, when the vessel faced hurricane force winds, with gusts up to 95 knots, and wild seas. The scientists and crew were there to carry out biodiversity research for the Ministry of Fisheries, in cooperation with the Italian Antarctic Research Programme, and to continue hydrographic survey work for Land Information New Zealand (LINZ).

The biodiversity research centred on the continental shelf of Antarctica, down to depths of about 1000 metres in the northwestern Ross Sea and the Balleny Islands and nearby seamounts. Thousands of specimens were collected, representing many hundreds of different species. Some are likely to be new to science and many are new records for the area, including the lithodid crab – a type of crab rarely found in Antarctic waters. The biodiversity research, which included an inventory of species, changes with latitude, and the effects of iceberg scour, helps to inform and guide effective environmental classification, management, and conservation of these marine ecosystems.

The successful hydrographic survey work means that we can now produce maps giving almost complete coverage of the shipping lanes from Cape Adare to south of Cape Hallett, as well as most of the accessible areas in the chart areas of Cape Adare, Cape Hallett, and Possession Island. The data complement the *Tangaroa* surveys of nearby areas in 2001, and will greatly improve safety for ships navigating the often hostile Ross Sea.

Databases

NIWA is using smart technology to tackle the problems of information overload. By bringing together previously unlinked databases in a user-friendly manner, the way is open for people to use the information for purposes the original data collectors may never have imagined. One of the most innovative aspects of this work is NIWA's ability to connect different types of spatial data using interactive web-maps.

FBIS: what lives in freshwater?

The new Freshwater Biodata Information System (FBIS) makes scientific records of at least 104 000 samples of freshwater fish, invertebrates, algae, and other aquatic plants available free at the click of a mouse.

Among the potential uses of FBIS:

- A regional council is considering an application for resource consent to take water from a river – FBIS can help identify what aquatic plants and animals live downstream.
- A developer wants to take water from a stream – FBIS might show that rare native fish live in it.
- An iwi is concerned that invasive plants could clog up a lake – FBIS can map the proximity of 'clean' waterways to infested ones, and track the spread of pest plants over time.

FBIS, which has been supported with funding from the Department of Conservation, is embedded in FINZ.

http://fbis.niwa.co.nz

FINZ: streams, rivers, lakes, estuaries, and groundwater

Freshwater Information New Zealand (FINZ) will provide interactive web-map-based access to environmental information on rivers and estuaries.

At the heart of FINZ is the River Environment Classification system which NIWA developed for the Ministry for the Environment. This contains information about every section of river in the country, including the climate, where the water is coming from, the catchment's geology and land cover, and the slope of that piece of river.

Among the potential uses of FINZ:

- A regional council is considering an application to allow discharge from a milking shed into a stream – FINZ contains estimates of the nitrogen load on waterways.
- A regional council is developing a plan for managing its rivers – FINZ shows whether a stream's lowest flow will be in summer (for a lowland stream) or in winter (for a mountain stream).
- A researcher might use FINZ to identify native forest streams for a study.

http://finz.niwa.co.nz

Ministry of Fisheries research databases

NIWA manages 33 marine fisheries databases on behalf of the Ministry of Fisheries, and they are used extensively by researchers both here and overseas. They include three new databases developed in the past year:

- A new marine biodiversity and biosecurity database.
- A database for commercial fisheries statistics from 1972 to 1988.
- A non-fish bycatch database for recording when fishing vessels catch a protected species.

Supercomputer upgraded to improve environmental forecasting

In May 2004, NIWA upgraded its Cray T3E supercomputer – by then five years old. The upgrade gives NIWA four times the computational capacity of the original system.

The supercomputer divides the workload between many powerful microprocessors, enabling it to solve massive problems. It has particular advantages over a cluster of equivalent processors when working on very complicated interconnected models because it can rapidly transmit data from processor to processor.

NIWA is using it to develop environmental forecasting as well as for climate modelling, ocean modelling, atmospheric chemistry, and fisheries modelling. The environmental forecasting will have many and varied applications, including giving planning agencies, such as government and emergency managers, the longest possible time to respond to flooding and coastal hazard predictions. By linking rainfall and wind data with storm surge and tidal information, NIWA can predict high and low river flows and storm damage from winds. The same system could be used, for example, to predict the dispersal of contaminants after oil spills, or pests and diseases after accidental release.

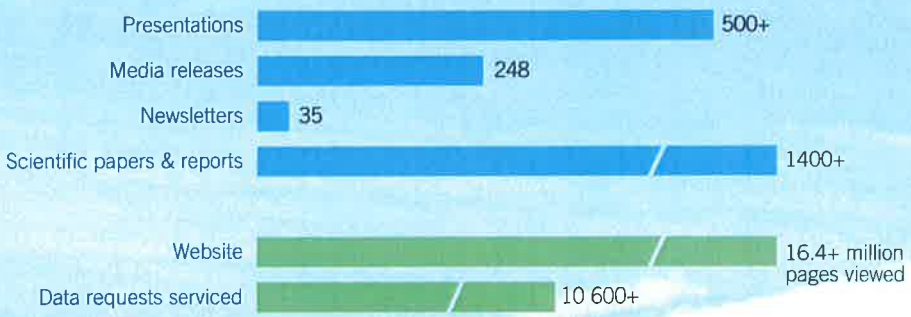
How we communicate our science

There are many ways in which we interact with you, but the key avenues are:

- our National Centres:
  Aquatic Biodiversity & Biosecurity
  Climate
  Climate–Energy Solutions
  Fisheries & Aquaculture
  Water Resources
  Natural Hazards
  Each Centre has a regular newsletter published in print form and online, produces regular media releases, schedules frequent meetings with major stakeholders and clients, and has its own webpage.
- our Māori research and development unit, Te Kūwaha
- education and training
- policy advice
- international research and services
- commercialisation

Some examples of our science communication are shown on the following pages

NIWA communications, 2003–04



National Centre for Aquatic Biodiversity & Biosecurity

protecting our natural heritage

NIWA's National Centre for Aquatic Biodiversity & Biosecurity provides information on freshwater and marine biodiversity and biosecurity. Our tools and services range from databases, identification guides, and habitat surveys, through to aquatic weed management strategies, habitat restoration studies, and the identification of toxic microalgae and introduced marine species.

Children explore their traditional kai moana reef

For the last 40 years, Makaurau Marae's taonga – their traditional kai moana reef, Ngā Kuia e Toru – has been adversely affected by the presence of the Mangere sewage treatment ponds. The reef disappeared beneath a dense covering of Pacific oysters and mud. As part of Watercare's Project Manukau, the ponds were removed and the reef opened up again in 2003.

Kaumātua of the marae identified the need to know about the marine resources on Ngā Kuia e Toru and to pass this knowledge to future generations.

We worked with Makaurau Marae to produce a field-based activity book for school children, in conjunction with TEAM (Teaching, Education and Management) Solutions, and ECOES (Ecological Solutions and Environmental Education), and we helped teach and supervise more than two dozen local children on a day-long hīkoi wānanga (field trip) to learn about the plants and animals on the reef. The children proved themselves keen young biologists, and developed an appreciation of the significance of this knowledge to them and to their marae.

Living waters

More than half the country's population and many major industries rely on abundant, clean water from aquifers in fractured rock under the ground. But few people are aware of the blind, colourless crustaceans and other animals (some up to 20 millimetres long) which live in the water – without light or plants – and help maintain its quality.

Our groundwater biologists are making significant advances in defining the biodiversity and ecology of these important habitats. We are examining the effects of water level fluctuations by using a series of new wells drilled alongside the Selwyn River in Canterbury, as well as investigating the effects of other human pressures elsewhere in the country. Such work is the basis of our advice to water managers and users about the likely effects of activities on the quality, as well as the quantity, of groundwater.

www.niwa.co.nz/ncabb

Amongst the **training courses** *we ran last year, this one was led by visiting German scientist Birger Neuhaus on meiofauna – tiny animals, less than 0.5 mm long, that live between sand grains or in mud. Meiofauna are sensitive to changes in their immediate surroundings and so are good indicators of the health of the environment.*

When dealing with **wind-borne pests**, *accurate and timely meteorological data and advice are critical. We installed a temporary weather station atop a 30 metre tower at Frankton, near Hamilton, to help the Ministry of Agriculture and Forestry, and their contractors, with the aerial spray programme used to combat the Asian gypsy moth incursion there. Three of our temporary automatic weather stations in Auckland remain dedicated to the painted apple moth eradication programme.*

National Centre for Fisheries & Aquaculture

generating wealth for New Zealand

NIWA's National Centre for Fisheries & Aquaculture works alongside the seafood industry, applying our knowledge and skills to increase the value and sustainability of the industry. We are a major source of information on New Zealand's fisheries, including fisheries biology, ecology, stock assessment, and population modelling. In aquaculture, we have expertise in culturing fish and shellfish, determining the capacity of areas to sustain aquaculture, and evaluating any impacts of aquaculture on the environment

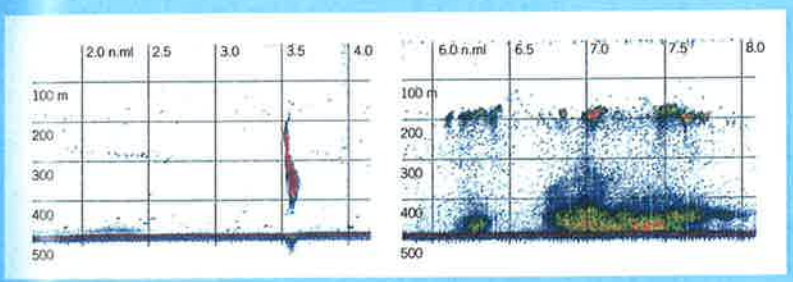
How do we know what could happen to fish stocks?

One of the tools we use is an advanced software package, CASAL, developed by our fisheries scientists. It allows us to model complex fish stock scenarios and predict what might happen under different fisheries management options. It does this without downplaying the inevitable scientific uncertainties of such predictions.

CASAL is being used for a dozen species, including hoki, orange roughy, and dredge oysters. It has begun to attract international attention, and is proposed for use in assessments of stocks of Antarctic toothfish in the Ross Sea.

On the mark: acoustic surveying from industry vessels

Conducting scientific research and commercial fishing from the same vessel may take careful planning and good cooperation, but it can be done. This year, our scientists worked aboard two industry vessels, operated by Independent Fisheries (west coast South Island hoki survey) and Sealord (southern blue whiting on the Campbell Island Rise). Their approach takes advantage of vessel down-time while a catch of fish is being processed. During processing, the vessel steams along a set path over a portion of the research area collecting acoustic data by using an echosounder and a hull-mounted transducer.



This echogram shows 'marks' from spawning southern blue whiting in the northeastern part of the Campbell Island Rise in September 2003. The work was funded by the Hoki Fishery Management Company as a pilot to investigate the feasibility of surveying this fishery by using industry vessels fitted with standard acoustic gear. The approach works well for small-scale acoustic surveys where the fish gather in large numbers to reproduce and where catch rates are high.

New technology for marine farming of rock lobsters

This year, the first rock lobsters produced using seacage farming technology were launched on to the market thanks to a partnership between researchers, industry, Māori, and Government.

The technology involves the sustainable capture of seed lobsters from the wild, a small, self-contained shipping capsule to keep them alive in transit, and specially designed seacages where the lobsters grow to market size. They are fed on fresh farmed mussels, thus creating the opportunity for mussel farmers to diversify and find a use for lower quality mussels which would generally be discarded.

The consortium of companies includes Konaki Aquaculture and Sanford, and the project was also supported with funding from the FRST and Te Ohu Kai Moana.

www.niwa.co.nz/ncfa

NIWA Research Director Rob Murdoch at the launch.

National Climate Centre

guiding responses to global change

NIWA's National Climate Centre helps New Zealanders prepare for and deal with climate variations. The Centre provides information on current climate conditions and the coming season's outlook. It keeps track of global influences on New Zealand's climate, including the El Niño-Southern Oscillation, the Interdecadal Pacific Oscillation, and sea surface temperatures. The Centre also advises on the likely impact of climate change.

Mapping rainfall

Abundant and regular rainfall is a vital natural resource, for agriculture, horticulture, hydroelectricity generation, and many other activities. But it can also be a hazard.

New Zealand's rainfall patterns are extremely diverse, due to our geographic location and complex terrain. As the balance between rainfall and the demand on water resources becomes finer, people need to know these patterns more precisely. The Centre uses information from NIWA's extensive national climate database, satellites, and climate models to produce maps at any scale that clients request, from the national picture to local detail.

Maps of annual, seasonal, or monthly rainfall totals, number of days of rain or soil moisture deficit, maximum 1-day rainfalls, or return period rainfalls help to define the rainfall resource and risk. The data from these maps can also be directly incorporated into any mapping software.

Adapting to climate extremes and change – a guide for local government

In March 2004, Parliament amended the Resource Management Act to require regional and district councils to take account of the effects of climate extremes and changes when they make decisions. Not surprisingly, councils frequently ask the question 'Will risks increase with climate change?'

NIWA has produced a manual to help local government understand and prepare for climate change. The manual was commissioned by the New Zealand Climate Change Office of the Ministry for the Environment and is available on the Ministry's website. It was prepared in collaboration with engineers, planners, and scientists from MWH and Earthwise Consulting.

The cost of the climate in dairy farming

A collaborative project between NIWA and the economic consultancy Infometrics has found that the climate in spring and summer can account for over half of the total variation in annual milkfat production in most regions.

The project assessed the effect that year to year variations in the climate have on milkfat production from dairy farms on a regional basis. We found that the worst year for milk production in the last 30 years was 1998–99, a La Niña year, when adverse climate conditions resulted in a 10% decrease in milkfat production nationwide. This equates to a reduction in GDP of about 0.4%, about $100 per person.

Being able to specify a possible climate and then to assess the economic effects has allowed us to run some 'what-if' scenarios for possible climate changes or for successive bad or good years. Using this approach, we can begin to assess the real economic costs and benefits of our changing climate.

www.niwa.co.nz/ncc

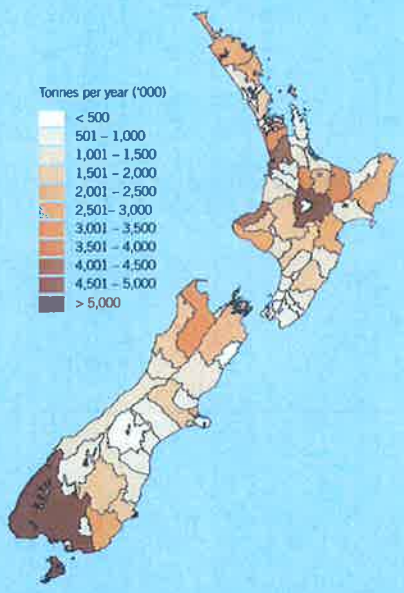
National Centre for Climate–Energy Solutions

finding the energy to move New Zealand forward

NIWA's National Centre for Climate–Energy Solutions is designed to help New Zealand with issues such as renewable energy, energy efficiency, greenhouse gas reductions, and reducing the environmental impacts of energy use.

Where are the greenhouse gases coming from?

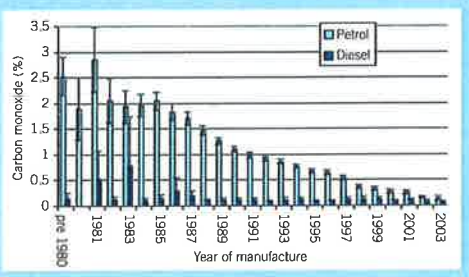
This map shows the total amount of greenhouse gas each region emitted in 2001. The Centre's calculations of regional emissions for the Inventory of New Zealand Greenhouse Gas Emissions are designed to help territorial authorities, Government departments, industry, and other groups develop effective policies to deal with greenhouse gases and other air quality concerns.



Regional maps have also been produced to show the distribution of greenhouse gas emissions from different sources: agricultural (livestock, soils, manure management, off-road vehicles); area (domestic and commercial fuel combustion, off-road vehicles, landfills, open burning, lawn mowing, refrigeration, wastewater); industrial; natural (vegetation, water, geothermal, volcanic); and transport (motor vehicles, rail, aviation, marine).

Finding the dirtiest vehicles

In 2003–04, we analysed emissions from over 40 000 vehicles, measured as part of an Auckland Regional Council campaign.



We looked at the effect of vehicle age, fuel type, imported vehicles, distance travelled, and Warrant of Fitness status on the emissions. Somewhat surprisingly, we found that imported Japanese used vehicles emitted lower levels of pollutants than New Zealand vehicles manufactured in the same year.

Such information suggests potentially cost-effective ways to target vehicle inspection and maintenance schemes, because it identifies the sections of the vehicle fleet which contain large proportions of 'gross emitters'.

The power of the sea

There is a huge amount of energy trapped in the motions of the seas, both waves and tides.

Our work suggests that more than 20 kilowatts of energy could be generated per metre of wave front around much of New Zealand. In other words, a typical 11 kilometre stretch of exposed coastline is impacted on average by as much energy as is produced by the Benmore hydroelectric power station. A study simulating wave conditions for the entire coastline for a 20-year-period is helping us to identify the best potential sites for wave energy generation.

Similarly, we have developed an overall picture of the speed and direction of tides around New Zealand, based on tidal measurements and numerical modelling. There are strong tidal currents near some islands, headlands, and straits. Flows are also particularly strong at the mouths of large inlets such as Manukau, Kaipara, and Hokianga Harbours, where the flow of water back and forth with the tide is 12 times larger than the strongest flow of floodwater in any New Zealand river.

www.niwa.co.nz/ncces

National Centre for Water Resources

making every drop count

NIWA's National Centre for Water Resources provides information and advice on river, lake, and groundwater conditions across New Zealand. It offers a variety of tools and services for use by water managers, including decision support systems for urban stream health and estuary sedimentation, 'LakeSPI' for monitoring lakes, and daily flood forecasts produced in collaboration with regional councils and unitary authorities.

One-stop shop for algal blooms

Blooms of hazardous blue-green algae in rivers, lakes, and reservoirs can cause problems for animals and people. But how can you tell whether an algal bloom could be toxic?

NIWA scientists give advice on algal blooms and their control, and we have set up a laboratory specialising in blue-green algae. We analyse the algae present, do cell counts, and identify potentially toxic species. We also conduct toxin testing for microcystin and nodularin toxins, in collaboration with AgResearch.

How to describe 426 000 kilometres of river

The River Environment Classification classifies sections of river based on the environmental attributes of the catchment, including its climate and the attributes of the valley that a river channel occupies, such as whether it is steep or flat. Being able to distinguish different sections of river is useful because the physical attributes of a river strongly determine features like its flow, water quality, and the species that may live there.

We developed the system, with support from the Ministry for the Environment and the involvement of a number of regional councils, to help people who manage, use, and study rivers – such as territorial authorities, electricity generators, and iwi.

The REC can be used as a tool for inventories of river resources, assessments of the effects of proposed activities, policy development, river monitoring programmes, interpretation of monitoring data, and state-of-the-environment reporting.

Just how much freshwater is there in New Zealand?

The Ministry for the Environment and Statistics New Zealand commissioned us to help develop the first ever physical stock accounts for freshwater. The accounts show inflows (such as from rain, snow, sleet, and hail), storage changes (water held in the soil, lakes, glaciers, and other places), and outflows (mostly flows to the sea or evaporation to the air). The accounts can help decision-makers, such as regional councils, assess how much water is available for use, and could be linked to economic statistics if the monetary value of water can be measured.

Gary DeRose measuring river flow rate in the Hutt River.

For the year to the end of June 2001, the accounts show total inflows of 407 billion cubic metres. But the outflows were estimated at 422 billion cubic metres. The difference of 15 billion cubic metres in the volume of freshwater stored in the system is attributed largely to low soil moisture at the end of June 2001.

www.niwa.co.nz/ncwr

Natural Hazards Centre

setting the foundation for a safer future

The Natural Hazards Centre is a joint initiative between NIWA and the Institute of Geological & Nuclear Sciences, bringing together expertise on the full range of natural hazards facing New Zealand. Its services are designed to help organisations and communities improve their resilience to natural hazards and better manage the risks.

Westport under water

NIWA's natural hazards scientists can combine forecasts of river floods with detailed inundation models to show just how deep and fast floodwaters could flow through any community. This image shows the water depths that are predicted in Westport if a 50-year flood of 8600 cubic metres per second were to coincide with a mean high-water spring tide and a 0.6 metre storm surge. Under that scenario, water would enter the town from both the Buller River on the left side of the picture and from the Orowaiti estuary on the right. The depth of colour indicates the depth of water, which ranges from 0 to 1.5 metres in the downtown area to over 8 metres in the Buller River.

Such models provide information for setting minimum floor levels for buildings, planning and evaluating flood defence works, warning residents of impending danger, preparing evacuation routes, and estimating potential economic losses.

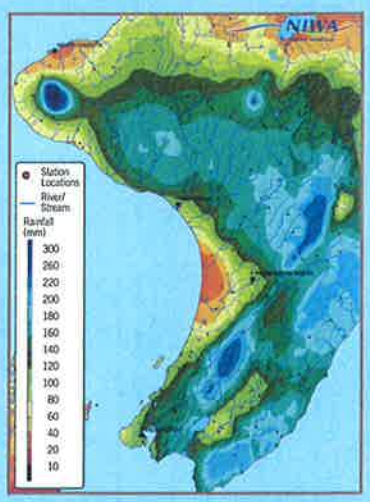
Quake risk revised

In the past, it has not been easy for geologists to identify accurately the location of important earthquake faults in Cook Strait, because the seabed is swept by strong tidal flows and incised by deep submarine canyons. Our multibeam acoustic mapping technology has changed all that.

This seafloor image shows the 'Boo Boo' fault as a sharp break, displacing the seafloor in the southern Cook Strait. From this we know the fault is longer and more active than previously thought, prompting a reassessment of the earthquake and tsunami risk it poses.

(Boo Boo fault is named after Boo Boo Stream near Cape Campbell.)

February – what a month!



The storms of February 2004 caused some of the worst flooding in 100 years in parts of the lower North Island. As the map of total rainfall for 14–17 February shows, the rain was particularly heavy in the hill country, contributing to the flooding downstream. In February as a whole, the Tararua ranges, for example, received 1288 mm – more than four times the normal amount of 300 mm.

With the possibility that such extreme weather may become more common in future, decision-makers need precise information to guide their planning. Our High Intensity Rainfall Design System (HIRDS) can estimate the frequency, depth, and duration of rainfall at any point in the country. HIRDS is used by city and district council planners and engineers designing stormwater drainage systems and other structures which need to cope with intense downpours.

www.naturalhazards.net.nz

Te Kūwaha

promoting Māori development

Kia hiwa rā! Kia hiwa rā!

E ngā reo, e ngā mana, e ngā matāwaka, e ngā tini kārangatanga maha huri noa i te motu, nau mai rā ki te whānau o Te Kūwaha, e mihi atu nei ki a koutou e whai mai nā i te mātauranga pūtaiao mai i te rangi ki ngā awa teretere, puta atu ki te moana hei oranga mō ō koutou hinengaro, mō ō koutou uri, otirā hei tikitiki mō ō tātou māhunga. Mā tēnei hononga ka mōhio te tangata e pēwhea ana ngā āhuatanga o tōna rohe, ka mutu ka whai kaupapa, kaha anō hoki ki te tiro whānui ki ngā āhuatanga o te ao hurihuri nui tonu. Heoti anō ānei ngā pitopito kōrero e whai ake nei hei whakamārama i tō mātou nei roopu – Mauriora!

Installing the new wind mast at Waipoua.

Renewable energy for remote communities

Te Kūwaha worked with two remote communities – Waipoua (Te Rōroa) and Waihi, near Taupo (Tūwharetoa) – to improve energy efficiency and to assess the potential for developing renewable energy sources.

Energy audits identified where energy efficiency could be improved, and buildings in each location were then retrofitted with such products as ceiling and underfloor insulation and efficient shower heads. Community members carried out the work, with training and assistance from Te Kūwaha, Negawatt Resources Ltd, and the Energy Efficiency and Conservation Authority.

Several months later, householders reported their homes were considerably warmer, drier, and quieter, smelt less of damp, and that they used two-thirds less firewood for space and water heating.

With assistance from each community, NIWA has installed monitoring equipment to assess wind, solar, and hydrological resources. The potential of wave power was also assessed at Waipoua. There, measurements suggest a combination of wind, solar radiation, and hydro could generate sufficient electricity to meet the community's needs. At Waihi, NIWA found micro-hydro appears the best option for connecting to the national grid, while there is also potential for small-scale solar power generation, and wind generation may yet prove feasible in the nearby ranges.

Glass eel aquaculture

Eel aquaculture continues to be a major focus for Te Kūwaha. For the past two years, weaning and growth trials have been carried out at NIWA's Bream Bay Aquaculture Park to assess the aquaculture potential of New Zealand's freshwater eel species. The results to date have been encouraging and the trials are continuing, with eels being fed a commercial diet.

Brendan Gara and Erina Watene with glass eels at Bream Bay.

Landbased marine aquaculture

A joint venture between Te Kūwaha and Hongoeka Development Trust aims to develop low-cost, land-based modular aquaculture systems for coastal iwi. The system will be based on the concept of polyculture – where two or more complementary species are grown in a single sustainable system. Seawater will recirculate through tanks of paua, tio (Pacific oysters), sea cucumbers, and karengo (a species of red algae).

Kelly May (left) and Sheryl Miller with the trial system at Mahanga Bay.

It is hoped the system would produce a sustainable harvest of about 1 tonne of paua each year. The tio and sea cucumbers will feed on the particulate matter produced by the paua, while karengo will be used to remove excess nutrients from the seawater. Low cost water recycling technology will be used to maximise water resources and space, with only a limited amount of new seawater required each day.

www.niwa.co.nz/rc/maori

Education & Training

NIWA's education and training activities promote science education and knowledge in schools and universities, and to the wider public. This year our sponsorship was strengthened by our association with Royal Society of New Zealand Science, Mathematics, and Technology Teacher Fellows Simon McMillan (freshwater and estuarine management), Mike Borek (stream ecology), and Robyn Bogue (environmental education).

Science and Technology Fairs

NIWA has a core interest in promoting science careers for young New Zealanders and is the major sponsor of the Regional Science and Technology Fairs in Auckland, Waikato, Bay of Plenty, Wellington, and Nelson. We provide additional sponsorship of the Central Northland, North Harbour, Taranaki, Nelson, Marlborough, Central South Island, South Canterbury, and Otago Science and Technology Fairs. These sponsorships promote science in secondary and intermediate schools and to the community at large.

Maihi Brown from Church College, Hamilton, won the Physical World and Sports Science sections of the 2003 Waikato Science Fair. Maihi found that the best conditions for kicking a rugby ball the maximum distance are: air pressure of the ball between 40 and 60 kPa; a fairly light leg mass which is easy to swing; and, most importantly, a high foot speed.

NIWA Discovery Room

More than 37 000 children visit the 'NIWA Discovery Room' at Kelly Tarlton's Underwater World in Auckland each year. NIWA's sponsorship of this marine educational facility is designed to help primary and intermediate age children discover the magic of science.

NIWA staff and a Royal Society Science, Mathematics, and Technology Teacher Fellow (hosted by NIWA) are developing materials for SEREAD, a **teaching resource** for Pacific Island schools based on the Argo float programme. Argo aims to deploy and maintain a global array of high-tech floats measuring temperature, salinity, and other features of the upper ocean. Through SEREAD, students learn about aspects of weather and climate, such as cloud formation and climate change. SEREAD also aims to improve teachers' understanding of the science, with three teacher training workshops held in the Cook Islands this year.

2003–04 saw NIWA consolidate its **links with New Zealand universities.** The joint NIWA and University of Auckland Institute of Aquatic and Atmospheric Sciences has now run successfully for three years. We also support postgraduate Centres of Excellence with Victoria University of Wellington, the University of Canterbury, and the University of Otago to attract the best students and train them at postgraduate level in areas of growing demand. NIWA staff supervised 68 postgraduate students across six universities last year. We currently provide five NIWA PhD scholarships in key areas, including aquatic ecology, biosecurity, marine fisheries, and aquaculture. Several of our students have received funding from FRST Enterprise Fellowships, Tūāpapa Pūtaiao Māori Postgraduate Fellowships, or Bright Future Fellowships.

We offered 13 sponsored and self-funded **training courses** in 2003–04 to assist in the professional development of staff in regional councils, Government departments, and consultancy organisations. These included courses in hydrology and data collection, and our popular freshwater biodiversity courses on topics such as native freshwater fish, wetland plants, and aquatic invertebrates.

Training courses in electric fishing, and identifying freshwater plants with Paul Champion.

NIWA also provided funding for 15 **postdoctoral fellowships** in 2003–04 in areas where we need high quality expertise, including marine biosecurity (2), biodiversity (3), aquaculture (2), and simulation modelling (3). We also provided internal educational opportunities for NIWA staff, with 1 **sabbatical leave** grant for senior staff, and 2 **technical training** awards in overseas institutions.

Postdoc Koustuv Debnath using the NIWA-designed and built in situ biophysical flume to measure streambed erosion.

International research & services

NIWA's international research and services reflect the diversity of its expertise at home. This year, NIWA scientists were engaged in work on every continent.

NIWA Australia

This year, we joined forces with the University of Queensland in looking at ways to improve the collection of ecosystem information on the Great Barrier Reef World Heritage Area. This ecologically important area is under some environmental stress and faces water quality problems from higher sediment and nutrient loads brought about by changes in land use.

We deployed NIWA's BIOFISH around the Whitsunday Island Group to examine how aspects of the environment, like light penetration, phytoplankton abundance, temperature, and salinity, varied across the area and from the surface down to depths of 40 metres. The survey provided a world-first, two-dimensional illustration of the water quality characteristics within the coastal fringe between Airlie Beach and Mackay.

Other projects included assessing the fate of different fertilisers in irrigated dairy pastures, providing shellfish disease monitoring services, modelling hydraulics and advising on fish passage through erosion control structures, and assessing the ecological value of wetlands constructed for stormwater treatment.

www.niwa.com.au

NIWA in the USA

NIWA has a three year contract with the Woods Hole Oceanographic Institution to assist in the Vertical Transport in the Global Ocean (VERTIGO) project.

The project is attempting to understand how materials get from the surface to the deep ocean as sinking particles. It looks at how effectively the ocean will continue to draw carbon from the atmosphere and store it in the water and in marine plants and animals.

Our consulting work for our US partners Limno-Tech Inc. included hydrodynamic modelling and an ecological risk assessment of a contaminated site used for zinc additives for paint.

We continued with our work for the University of Massachusetts calibrating and maintaining two microwave sensors, one in Hawaii and the other in Central Otago, which contribute to international research on ozone depletion.

www.niwa-eri.org

Fisheries outside New Zealand

NIWA worked with the Irish Marine Research Institute on acoustic surveys of blue whiting in the northeast Atlantic and on the development of assessments for orange roughy. Irish scientists have visited NIWA for training in methods of ageing deepwater species and deepwater acoustic techniques.

We collaborated with Instituto de Formento Pesquero in Chile to review orange roughy stock assessments and to assist with acoustic surveys of middle depth species.

We continue to make a significant contribution to the management of Antarctic fisheries through Ministry of Fisheries contracts for assessments of toothfish and associated species, particularly in the Ross Sea region, and a NIWA scientist is the convenor of the stock assessment working group of CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources).

We contributed to discussions in Kenya on appropriate management and assessment of fisheries in Lake Victoria. This project was funded by the New Zealand Agency for International Development (NZAid).

Fishing on Lake Victoria.

Assisting outer-island development in Tuvalu

Tuvalu is one of the smallest and most isolated island nations in the world. Only two of the archipelago's nine islands have natural passages enabling ocean-going ships to enter their lagoons. For most of the outer islands, the two inter-island ferries must sit in deep water offshore while small tenders make the hazardous trip through breaking waves at the edge of the fringing reefs to carry people and cargo to and from shore. All of the outer atolls have at least one man-made channel through the reef to help these tenders get through.

NIWA worked with the South Pacific Applied Geoscience Commission (SOPAC) and the government of Tuvalu to assess the social, economic, and environmental impacts of the reef channels. The study, funded by NZAid, found the islanders credited the channels with bringing important social and economic benefits. It did not find significant environmental impacts, though erosion of some islands is exacerbated by the combination of the channels and more recently constructed concrete beach ramps.

Unloading the tenders on Nui atoll as the inter-island ship Manu Folau *sits offshore.*

Pete Mason conducting hydrological training near Suva, Fiji.

Water resources in the Pacific

For small island states to be able to manage their precious water resources effectively, they need to monitor rainfall, river flows, and current water storage levels. This, together with the capacity to interpret seasonal climate forecasts, will make for more resilient communities in the Pacific. This year, NIWA (in association with SOPAC) conducted the first of a series of two-week intensive training courses (with the support of NZAid) for hydrologists and water resource managers.

Blind spots on the Blue Planet

The ability of scientists to help address many of the world's seemingly most intractable problems, such as drought, the outbreak of diseases, and the impact of the climate on agricultural production, is hindered by 'blind spots' in information about Earth.

The Group of Earth Observations (GEO) is a G8 initiative tasked with working out how to fill gaps in observations of the planet, covering issues such as precipitation, soil moisture, and ocean salinity, and a New Zealand delegation attended the Earth Observation Summit and the associated meeting of the GEO in Tokyo.

But data collection is only the first step. NIWA has embarked on initiatives in the Pacific to help small island states develop their capacity to use new and existing observations in their resource management decisions. For example, NIWA staff played a key role in two weeks of intensive training on extreme climate events at the University of the South Pacific in June. The training was supported financially by the Asia-Pacific Network (APN) and the National Oceanic and Atmospheric Administration (NOAA).

Andrew Matthews with Vice-Admiral Lautenbacher, US Under-Secretary of Commerce for Oceans and Atmosphere and co-chairman of GEO, at the Tokyo meeting.

Monitoring the Pacific's climate

The tropical cyclone season over the South Pacific started late in 2003–04. But then Cyclone Heta hit Niue with devastating force in early January, with maximum sustained wind speeds up to 260 km/h and gusts of 300 km/h.

Of the 32 seasons for which NIWA has satellite observations, only 40% of years had no tropical cyclone by mid December. Late starts to the tropical cyclone season tend to coincide with neutral or La Niña conditions.

NIWA's National Climate Centre provides this sort of information to small Pacific Island states through a monthly newsletter, *The Island Climate Update*, to help agencies plan activities ranging from tree-trimming in preparation for tropical cyclones to crop planting. *The Island Climate Update* is produced with the support of NZAid, through SOPAC, and is available free on the web: www.niwa.co.nz/ncc.

Contributions to New Zealand's international obligations

NIWA contributes substantially to New Zealand's commitments under international conventions and obligations, such as the Vienna Convention for the Protection of the Ozone Layer (and Montreal Protocol), the UN Framework Convention on Climate Change (and Kyoto Protocol), the Antarctic Treaty System, and the Rio Convention. NIWA provides scientific expertise and supplies the New Zealand representative for a wide variety of international bodies. In carrying out these tasks NIWA works closely with the Ministry of Foreign Affairs and Trade (MFAT), Ministry for the Environment (MfE), Ministry of Agriculture and Forestry (MAF), Department of Conservation (DoC), and Ministry of Fisheries (MFish).

Climate change

NIWA staff serve on the Bureau of the Intergovernmental Panel on Climate Change (IPCC), which guides planning for the IPCC assessments used by governments and the UN for policy development. The Fourth Assessment Report has four NIWA scientists serving as lead authors for chapters.

We have contributed to international policy documents, including acting as a co-author on an IPCC/TEAP report 'Safeguarding the ozone layer and the global climate system: issues related to hydrofluorocarbons and perfluorocarbons'. This report provides policy advice on the potential environmental impacts (both on climate and ozone) from the use of a wide range of industrial chemicals.

We also contributed to the International Ozone Commission (IOC), Commission on the Middle Atmosphere, UNEP Effects Panel, and Network for the Detection of Stratospheric Change (NDSC).

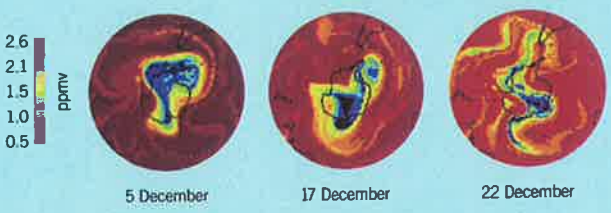
In collaboration with MfE, we provide input to the ad hoc working group established by the UNFCCC to investigate the scientific and methodological issues associated with the Brazilian Proposal to the Kyoto Protocol.

We also contributed to the establishment of research projects for the US-NZ Climate Change Partnership. The partnership, established in 2003, provides a means of enhancing collaboration on climate change issues, and during this year NIWA began new collaborative projects on global methane emissions and the rescue of historic climate data.

Antarctica

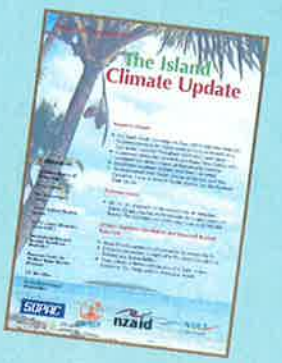
NIWA has a substantial scientific presence in Antarctica and contributes to international committees on the management of science. The Scientific Committee on Antarctic Research (SCAR) is tasked with coordinating and promoting international science in Antarctica. NIWA currently provides the New Zealand representative for SCAR, who is also SCAR's vice-president. Southern Ocean activities are also prominent, with NIWA staff contributing to the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). A NIWA staff member is the convenor of the working group for fish stock assessment, and staff contribute to the Stock Assessment Methods Group and provide stock assessment advice to MFish for Ross Sea toothfish. We also contributed to the development of Antarctica New Zealand's environmental and science policy.

NIWA provides ozone measurements from Scott Base, Antarctica, to the World Meteorological Organization (WMO). This information contributes to the WMO Antarctic ozone bulletins that are distributed internationally during the period of substantial ozone loss every spring.



Ozone in the stratosphere for three days in December 1998; before, during, and after the breakdown of the Antarctic ozone hole. As the hole breaks down, ozone-depleted air mixes with the surrounding air further north, diluting the amount of ozone over the region encompassing New Zealand and Australia. Our analysis for the years 1998, 1999, and 2000 shows the ozone hole has resulted in 5–6% less ozone on average in mid latitudes in spring and summer. This corresponds to 6–7% more sunburn-causing UV.

Other international research and programmes

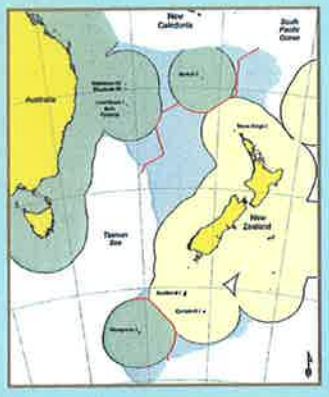


New Zealand supplies seasonal climate outlooks for southwest Pacific Island nations in *The Island Climate Update*, produced by NIWA in collaboration with 17 Pacific meteorological agencies. This work is supported by NZAid, the South Pacific Regional Environmental Programme, and the South Pacific Applied Geophysics Commission.

NIWA vessel *Kaharoa* successfully completed two substantial voyages this year to deploy profiling floats as part of the international Argo programme. During the first voyage, 30 floats were deployed across the Pacific between New Zealand and South America, and 31 were launched on the return trip. The floats create a monitoring network across the oceans, returning information on temperature and salinity for inclusion into global data sets and models of ocean behaviour and climate.

The Argo network, comprising 1270 floats, June 2004.

NIWA has successfully concluded its role in the United Nations Convention of the Law of the Sea (UNCLOS) negotiations with Australia. The UNCLOS agreement between New Zealand and Australia significantly extended New Zealand's sovereign rights for exploring and exploiting its natural resources over continental shelf territory in the Tasman Sea, enclosing an area of about 735 560 square kilometres beyond the New Zealand EEZ. Under contract to MFAT, NIWA and the Institute of Geological & Nuclear Sciences have over the last eight years provided the technical basis for New Zealand's case and participated as advisors in the negotiating delegation.



NIWA is collaborating with NASA, Jet Propulsion Laboratory, the California Institute of Technology, and the University of Wollongong to establish a Network for Atmospheric Carbon Observations in the South Pacific and Southern Ocean. The network will contribute to a new global initiative to combine Orbiting Carbon Observatory (OCO) satellite measurements with ground-based column and in situ measurements of key global change greenhouse gases (carbon dioxide, methane, and carbon monoxide). This work, with carbon cycle modelling, will improve our understanding of the sources and sinks of carbon in the South Pacific, and how they will influence future world climate. The network is closely aligned with several of the New Zealand Government's objectives in climate change research, and is a new element in the climate change partnerships between New Zealand, the USA, and Australia.

John Robinson using the Fourier Transform Spectrometer at Lauder to measure greenhouse gas columns (the total amount of a gas between the ground and the top of the atmosphere).

Other NIWA memberships include the World Meteorological Commission on Agricultural Meteorology, the International Global Atmospheric Chemistry Programme, the Ocean Biogeochemistry & Ecosystems Programme, and the International Geosphere Biosphere Programme (IGBP), in particular the Land Ocean Interchange in the Coastal Zone (LOICZ) and Surface Ocean Lower Atmosphere Study (SOLAS). NIWA participation in SOLAS focused on a *Tangaroa* voyage to study air-sea gas exchange in the Southern Ocean, a voyage which included scientists from New Zealand, Australia, the USA, and Europe.

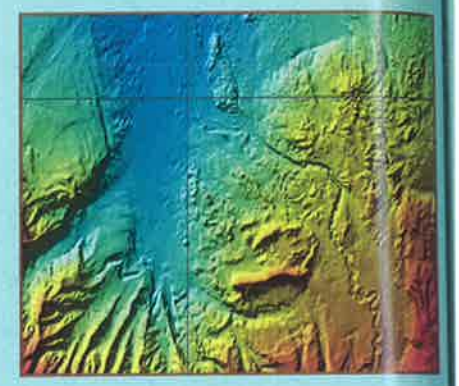
Contributions to Government policy and operations

NIWA provides substantial input to New Zealand Government bodies, at a national, regional, and territorial level, to help them evaluate costs and benefits of alternative strategies, assess the relative risks and impacts of different human activities on the environment, and improve decision-making.

At a national level, we work closely with the Ministry for the Environment (MfE), Ministry of Agriculture and Forestry (MAF), Department of Conservation (DoC), Ministry of Fisheries (MFish), Energy Efficiency and Conservation Authority (EECA), New Zealand Treasury, Ministry of Foreign Affairs and Trade (MFAT), Te Puni Kōkiri, Ministry of Economic Development (MED), Land Information New Zealand (LINZ), Ministry of Civil Defence and Emergency Management (MCDEM), Ministry of Transport (MoT), Land Transport Safety Authority (LTSA), and Maritime Safety Authority (MSA). We also work with all regional councils and unitary authorities and most district and city councils.

Marine environment

NIWA provides advisory reports on the geology and morphology of the seabed around New Zealand to LINZ in support of the Continental Shelf Project. This work forms an essential part of our national submission for extension to our Continental Shelf as described in Article 76 of the United Nations Convention on the Law of the Sea. NIWA staff also provide input to the development of research priorities to meet future ocean management needs by the Oceans Policy group of MfE. We provided baseline data on marine communities to DoC for specific areas to guide locations of coastal marine protected areas. We also worked with MfE on the development of a marine classification scheme to guide management of New Zealand's Exclusive Economic Zone, including recognition and conservation of unique ecosystems.



Natural hazards

NIWA contributed to the MSA environmental assessment task force report. This report outlined NIWA's expertise in monitoring, modelling, and forecasting maritime hazards. New models were developed that combined river flow and tidal information to provide flood inundation estimates for coastal locations. These have been supplied to the Buller District Council to estimate flood risk in Westport. NIWA is a member of the science cluster that MCDEM has established to provide technical input into hazard management.

Climate

NIWA and the Pastoral Greenhouse Gas Research Consortium organised a joint workshop on greenhouse gas emissions. This brought together Government agencies (MAF, MfE Climate Change Office), science providers, and representatives from the agricultural sector to review science progress towards understanding emissions and mitigation options. We provided two comprehensive reports for the Climate Change Office to help guide regional councils across New Zealand in assessing the likely effects of projected climate change and planning appropriate responses. The reports considered both the land-based and coastal impacts of climate change.

Databases and collections

NIWA provides access to Nationally Significant Databases or collections on Climate, Water Resources, Freshwater Fish, and Marine Benthic Biodiversity. We also maintain fisheries databases for MFish and provide facilities and services for the maintenance of and access to hydrographic data for LINZ.

Aquaculture

NIWA helped MFish develop new guidelines for Fisheries Resource Impact Assessments (FRIA) required to enable permits to be issued for new mussel farming activities. These new guidelines not only enable a more holistic approach to development for specific regions, but also provide a cost-effective solution for mussel industry companies in meeting requirements of permit applications.

Biodiversity

NIWA prepared a report for DoC's Marine Conservation Unit to inform the public about Marine Protected Areas.

We contributed to the development of MFish's medium-term research plans for both marine biodiversity and marine biosecurity. We also made submissions to the committee developing the National Biosecurity Strategy; conducted training courses on freshwater organisms for regional councils and DoC; developed techniques for measuring biodiversity in ephemeral waterways such as springs and seeps for DoC; and reviewed all the bio-information on the oceans around New Zealand's subantarctic islands for DoC as a basis for assessing the need for Marine Protected Areas in this region.

The extraordinary biodiversity of the Ross Sea.

Parrots feather is classified as an unwanted organism.

Biosecurity

NIWA provided MAF with atmospheric measurements and modelling in relation to the spread of airborne pests such as the painted apple moth and we provide on-call services for pest outbreaks. We carried out reviews on exotic fish (their spread and potential control) for DoC and regional councils – specifically, a report to Environment Bay of Plenty and DoC on the spread of tench by anglers. We identified 40 species of native aquatic plant for promotion as preferred species for the ornamental pond trade as part of the DoC 'Terrestrial and Freshwater Biodiversity Information Systems Programme', as a means of restoring endangered or rare native species and reducing the spread of introduced species.

Air quality

The recently published MfE guidelines for dispersion modelling of atmospheric pollutants was based on work by NIWA. We also contributed to the development of specific air quality management plans, for example, for Nelson.

Antarctica

NIWA provided significant input to the US-NZ proposal to the Antarctic Treaty System for the establishment of an Antarctic Specially Managed Area (ASMA) covering the Dry Valleys area of South Victoria Land. The ASMA was officially confirmed in June 2003.

Freshwater resources and catchment management

NIWA information was included in MfE's Rotorua Lakes Plan. We participated in the Environment Bay of Plenty Technical Advisory Group for the Rotorua Lakes, and MfE's Taupo 2020 Project. NIWA modelling and catchment studies were used in Cabinet decisions on Lake Taupo. Our farm nutrient modelling was included in Environment Bay of Plenty's Regional Water Plan. Groundwater fauna are now recognised in the Canterbury Draft Regional Water Plan after NIWA research and presentations to Environment Canterbury. The Marlborough District Council has adopted the NIWA internet-based data retrieval system, and NIWA's data transfer system now provides links for hydrological data to Environment Waikato, Environment Bay of Plenty, Environment Canterbury, Environment Southland, and the Northland, Auckland, and Taranaki Regional Councils. We also provided a regional water flow allocation model and a minimum flow model for different river types for the Environment Southland Draft Regional Water Plan.

NIWA prepared a national assessment of trends and spatial patterns in water quality for MfE and made a major contribution to the first set of national water accounts with Statistics New Zealand. We developed water quality standards and assessed the effect of forest planting on water resources for Environment Canterbury's Draft Regional Water Plan.

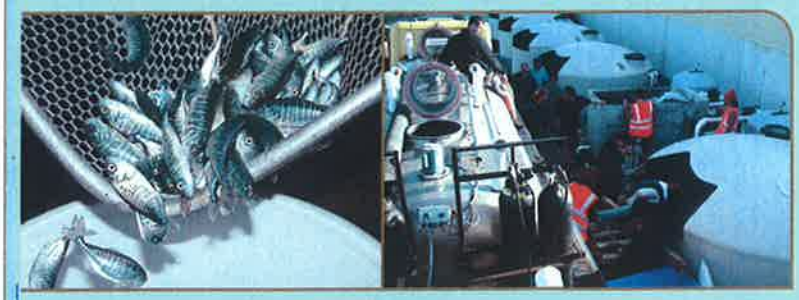
NIWA worked with the West Coast Regional Council, Westland Milk Products, and Dairy Insight to confirm the establishment of an experimental dairy catchment in the greater Lake Brunner catchment to study mitigation options against runoff to this sensitive lake.

NIWA also worked with the Auckland Regional Council and territorial authorities on predictions of locations and rates of contaminant accumulation in the estuaries of the Upper Waitemata Harbour over the next 100 years. These will be used to set policy and plans for catchment development.

Commercialisation

Bream Bay attracts new business

For the second year running, NIWA has delivered tens of thousands of kingfish fingerlings to commercial ongrowers – commercialising hatchery technology developed by NIWA. We have secured a four-year supply contract with Parengarenga Fish Farms to supply fingerlings for their land-based kingfish farm, the first of its kind in New Zealand. The kingfish commercialisation has already attracted millions of dollars of investment into the Northland economy and substantial further growth is anticipated.



Transport of juvenile kingfish from Bream Bay.

Bream Bay also has two commercial partners (Sealord and OceaNZ Blue) who have developed the largest commercial shellfish hatchery facilities in the country, and are raising tens of millions of greenshell mussel seed and paua for ongrowing.

In total, Bream Bay Aquaculture Park has directly attracted about $20 million of investment in aquaculture into the Northland economy, and more than 30 new full-time jobs have been created.

Salmon sales soar

From the 2003 salmon spawning season a total of 825 000 chinook salmon seed stock were provided to commercial salmon farms and sports fishery agencies throughout the South Island. We can provide them in a variety of sizes from 5 to 100 grams, and smolts are produced from captive broodstock in a variety of forms, including mixed stock, all female stocks, and triploid salmon. As well as these commercial sales, we donated several hundred thousand eyed ova and some mature adult salmon to North Canterbury Fish and Game for distribution into natural waters in an effort to augment the wild fisheries that are at record low levels.

Nelson Boustead holding salmon broodstock in the NIWA fish tanker.

The electronic ID tag and tag sensor.

NIWA Natural Solutions markets commercial opportunities

NIWA Natural Solutions capitalises on commercialisation opportunities that arise from NIWA's science in three main areas – aquaculture, marine natural products, and environmental solutions. One of its key roles is to bridge the gap between research and early stage development, where risks are often high, technology complex, and returns uncertain. Initial projects include a food safe plastic encapsulated electronic ID tag for use in marine and animal industry applications, and a marine probiotic that increases aquaculture farm productivity while eliminating antibiotic use.

A new joint venture – TerraMarine

In December 2003 a joint venture between NIWA, Crop & Food Research, and Malcorp Biodiscoveries was formed to discover and commercialise non-steroidal anti-inflammatory drugs based on New Zealand's plants and animals. Other important collaborators on this programme include the universities of Auckland and Otago, clinicians, and pharmaceutical industry advisors.

TerraMarine
PHARMACEUTICALS

What we want to do as a company & how we are doing it

Sustainable Development Report

Background

What we want to do as a company

Commitment to sustainable development

NIWA recognises the importance of contributing to sustainable development and operating in a sustainable manner in order to achieve economic, environmental, and social goals. NIWA's research and services that provide the basis for New Zealand's sustainable development must go hand in hand with improving our economic, environmental, and social performance. NIWA's mission statement and vision reflect this commitment by stating that we provide a sound scientific basis for sustainable use of our natural resources and derive benefits from them in a sustainable manner while providing economic growth. In support of this mission and vision, our values include contributing to environmental sustainability through developing and maintaining core capabilities to deliver leading edge science and innovative services focused on the natural environment, taking social responsibility, and ensuring staff are treated fairly and equitably and are in a safe and healthy work environment. Striving to meet these goals not only contributes to sustainable development, but also has economic benefits through cutting costs, reducing risks, and adding value for the shareholder.

NIWA continues to promote sustainable development through its involvement in the New Zealand Business Council for Sustainable Development, has a representative on the Executive Committee, is project champion for the Council's major project on climate change, has members on national and international environmental and conservation committees, and has set up its own Sustainable Development Committee.

Sustainable development reporting

The Crown Research Institutes Act 1992 sets out the principles under which CRIs operate. NIWA is committed to these principles, which include:

- undertaking research for the benefit of New Zealand,
- pursuing excellence in all its activities,
- complying with all ethical standards while carrying out its activities,
- promoting and facilitating the application of the results of research and technological developments,
- being a good employer,
- maintaining financial viability.

These principles form the basis of NIWA's non-financial performance measures which are agreed each year with the shareholding ministers as part of our Statement of Corporate Intent (SCI). These measures are now integrated into the Sustainable Development Report section of the annual report with a description of our performance against targets, new initiatives, the challenges we face, and how we can improve in the future.

NIWA's non-financial performance against targets identified in the SCI for the 2003–04 financial year were as follows:

Non-financial performance indicator	Actual 2004	Target 2004	Actual 2003
Research output*			
Papers in international, externally refereed journals	307	280	278
Papers in local, internally, or editor-refereed journals	183	130	132
Conference papers and other presentations	724	800	674
Research monographs and books	82	65	64
Popular books	1	2	2
Client reports	510	450	487
** measured over a calendar year.*			
Application & promotion of science			
Value of consultancies to NZ users	$27M	>$20M	$23M
Achievement of technology transfer objectives in FRST contracts	99%	95%	99%
Value of TBG and Technet contracts	$440K	$800K	$312K
Requests serviced for information from NIWA's nationally significant public-good databases*	10,664	9,700	9,649
Magazine and newspaper feature articles plus TV and radio interviews	248	180	185
Number of patents/licences owned	4		4
** includes automatic climate updates that were accessed.*			
[TBG – Technology for Business Growth]			

NIWA's research output has continued to increase, particularly client reports where we are providing services to commercial clients (revenue now $27M), requests for information serviced by our databases, and media articles. These demonstrate our commitment to technology and information transfer while maintaining a high level of output in scientific journals. The development during the year of a web-based automated system for climate data queries contributed to the increase in requests serviced from NIWA's nationally significant databases.

Staff composition (incl. subsidiaries)	Actual 2004	Target 2004	Actual 2003
Research teams	438	440	450
Research support	47	50	51
General support	96	92	97
Marketing and promotion	7	7	6
Management	24	23	23
Total	612	612	627
% male:female	72:28	74:26	74:26
Turnover (%)	7.7	8	8

Staffing levels in science, support, and vessels were reviewed during the year and were reduced where the level of full-time positions could not be supported. These numbers were balanced to a certain extent through the acquisition of a small manufacturing company with 14 staff (included in the figures above). Turnover has remained steady after an increase in 2002–03.

Age profile (%) by 10 year age groups for NIWA and its subsidiaries (ex Unidata)

Category	<20	20–29	30–39	40–49	50+
Research teams	0.0	8.2	29.8	32.6	29.4
Research support	0.0	2.2	22.2	26.7	48.9
General support	1.1	16.1	22.6	26.9	33.3
Marketing and promotion	0.0	0.0	14.3	42.9	42.8
Management	0.0	0.0	4.2	41.6	54.2
Total	0.2	8.5	26.9	31.8	32.6

Sustainable Development Report

Staff numbers, turnover, and age composition for NIWA and its subsidiaries (ex Unidata) for the year ended 30 June 2004

Category	No. of staff	No. of FTEs	Turnover (%)	Average age (years)
Research teams	429	423.5	5.5	43.1
Research support	45	44.5	6.3	47.6
General support	93	89.0	15.8	42.8
Marketing and promotion	7	7.0	0.0	47.4
Management	24	24.0	8.5	48.9
Total	598	588.0	7.7	43.7

Benefits from NIWA's science to New Zealand's sustainable development (What we do as a company)

NIWA's core business is providing scientific advice, services, and products that underpin the sustainable development of New Zealand's natural resources. Examples for 2003–04 include:

Sustainable management of marine resources

- NIWA developed a regional initiative to satisfy the Ministry of Fisheries requirement for Fisheries Resource Impact Assessment (FRIA). The initiatives were an innovative and cost-effective solution which contributes to the sustainable development of marine farming in the Marlborough region and involved MFish, the New Zealand Marine Farming Association, and the Marlborough District Council.
- NIWA were involved in a number of stock assessments of wild fisheries, including hoki, orange roughy, snapper, surf clams, and scallops. Estimates of recruitment and stock levels have helped MFish set sustainable catch levels.

Sustainable use of freshwater resources

- The first stage of a decision support tool to predict the effects of climate variability on changes in freshwater resources has been completed. This will be used to predict long-term changes in the resources and aid management decisions on sustainable water allocation in the coming year.
- Generalised habitat models were developed to enable flow requirements for freshwater fish to be determined at a regional level using the River Environment Classification system developed by NIWA and the Ministry for the Environment. The first application of this initiative was to the Southland region as a part of their sustainable water plan.

Sustainable land use

- Integrated catchment models have been developed which link catchment and downstream effects on water bodies. These studies have been instrumental in the development of management plans, assisting with Cabinet decisions on funding and setting criteria for the Rotorua Lakes and Lake Taupo. An example is the 20% reduction in nitrogen inputs from the catchment, which is required to maintain Lake Taupo water quality.
- New land management plans have been developed as part of the Whatawhata Sustainable Land Management Plan. These plans are designed to improve both economic and environmental performance, and have shown the benefits of actions such as excluding stock from waterways in protecting water quality.

Sustainable management of biodiversity and biosecurity

- A third regional report has been completed for the United Nations Convention on the Law of the Sea as part of a programme aimed at mapping oceanic resources on the continental shelf. New Zealand has sovereign rights for exploring and utilising these resources in a sustainable manner.
- Good progress was made in developing habitat suitability index models for unwanted marine organisms. This project combined spatial information on environmental conditions in New Zealand harbours and estuaries with invasive species habitat suitability rankings and hydrodynamic models of particle dispersal to identify high-risk areas that could be targeted for surveillance.

Improving quality of life in cities, towns, and rural areas

- NIWA has developed a GIS-based (Geographic Information System) air pollution exposure mapping tool for the Auckland Regional Council (ARC) which links population density, traffic flow, and vehicle emissions. NIWA and the ARC completed emission testing of vehicles in Auckland to provide better estimates of the level of pollution and the contribution to greenhouse gas levels from this source. This will significantly advance urban air quality monitoring and energy efficiency research in response to the Kyoto Protocol.
- An automated GIS-based system for the real-time display (and daily updating) of daily rainfall accumulations across the country has been developed. These data will be provided through the National Climate Centre website and will be of interest to the energy sector, agriculturalists, and all those involved in sustainable water allocation issues.

Renewable and alternative energy sources

- NIWA was involved in a number of studies on alternative energy sources, including wind energy modelling for the Far North and Auckland regions and assessments of solar power potential.
- A New and Emerging Energy Technology team completed an assessment of renewable energy resources and community energy use at sites in Taupo and Northland. These are aimed at small-scale developments using local renewable resources.

NIWA's commitment to sustainable development (How we do it)

NIWA is committed to operating in a sustainable manner. This commitment recognises the links between economic, environmental, and social performance and the importance of minimising the consumption of natural resources and the impacts of our activities on the natural environment.

In the 2003–04 Business Plan a number of performance targets were set to demonstrate our commitment to reducing energy consumption and our contribution to carbon dioxide emissions. Performance against these targets is reported in this section with new initiatives and achievements and the development of baseline levels and targets for waste disposal and recycling.

Sustainable Development Report

During 2003–04 a Sustainable Development Committee, representing staff and management, was set up to provide a focus for sustainable development and reporting. Specific objectives of the committee are to:

1. improve and promote awareness and acceptance of staff on sustainable development activities and reporting,
2. promote systems and processes which provide information on non-financial performance measures and targets,
3. promote and coordinate recycling efforts,
4. monitor, report on, and encourage reductions in emissions, waste production, and energy use.

Progress on these objectives is reported below.

NIWA's project management system has been developed over a number of years and was revised during 2003–04 to better reflect client needs and integrate the need for sound financial management and compliance with environmental and health and safety policies.

Economic sustainability

Economic sustainability addresses NIWA's impact on the economic circumstances of its stakeholders and their economic systems. As a Crown Research Institute, NIWA is required to be financially viable and to undertake research for the benefit of New Zealand.

Customers

The value of services and products provided to our customers is reflected by the value of revenue recognised.

Total revenue

NIWA Group for the year ended 30 June

2002	$81.3M
2003	$84.2M
2004	$84.6M

During the year we expanded our investments into new strategic areas. A new, fully owned subsidiary, NIWA Natural Solutions Ltd, was created to assist with the commercialisation of new products and technologies identified and developed by NIWA.

We also expanded operations in Australia by acquiring an 80% share in Unidata Pty Ltd. Unidata is a supplier of environmental technology products. As Unidata provides instrumentation that is crucial for our monitoring networks, the acquisition not only expands our geographical market, but also ensures that we can sustain our monitoring networks.

Environmental monitoring networks are a key asset for New Zealand because they enable us to monitor and forecast environmental factors which affect our stakeholders. These include factors such as climate change, rainfall, and lake water levels, which provide information on hydrogeneration capacity and soil moisture content for agriculture. The network is also part of New Zealand's early warning system for natural hazards such as floods.

Suppliers

We support our suppliers and subcontractors by our endeavours to pay them in a timely manner in accordance with agreed terms.

Cost of all goods, materials, and services purchased

NIWA Group for the year ended 30 June

2002	$38.8M
2003	$35.2M
2004	$36.2M

Employees

Total payroll and benefits

NIWA Group for the year ended 30 June

2002	$38.5M
2003	$41.5M
2004	$41.9M

Providers of capital

NIWA did not have any interest bearing debt as at 30 June 2004. Changes in economic value to our shareholders are:

Operating surplus before tax

NIWA Group for the year ended 30 June

2002	$7.5M
2003	$7.2M
2004	$7.0M

Return on equity

NIWA Group (net surplus/average shareholders' funds)

2002	9.6%
2003	10.6%
2004	10.7%

Public sector

Total taxes paid to the New Zealand Inland Revenue Department are shown below. Taxes paid in other countries were minimal because tax losses were carried forward.

Taxes paid

NIWA Group for the year ended 30 June

2002	$2.9M
2003	$3.3M
2004	$1.5M

Environmental sustainability

Environmental sustainability identifies the need to maintain the environment in at least its present state, thereby ensuring that future generations receive the same benefits. NIWA acknowledges this responsibility and is acting accordingly to minimise its impacts.

NIWA's Environmental Policy recognises the need to conduct all activities to a high standard of environmental awareness through compliance with relevant legislation, taking all practical steps to minimise any impact, having contingency plans in place for accidental spills, minimising consumption of resources and waste production, and striving to improve our environmental performance.

Resource use

NIWA is a foundation member of the Energy Wise Government Programme, which is administered by the Energy Efficiency and Conservation Authority (EECA). We are committed to practising energy efficiency throughout our premises, plant, and equipment wherever it is cost effective.

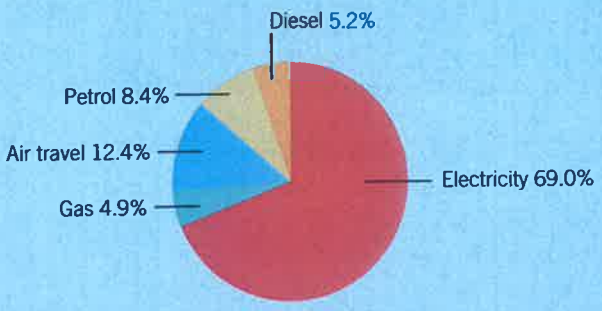
We audited energy use at our largest sites and established baselines for current energy use for our New Zealand-based operations. Potential energy-saving mechanisms were investigated, and we have taken a number of steps to reduce energy use in 2003–04, including increasing staff awareness at staff meetings and in newsletters, extending a building management system at one of our major sites, and installing energy efficient lighting and heating controls. *The goal for our New Zealand-based operations is to achieve at least a 15% saving per full-time staff equivalent in our use of electricity and gas (from the baseline for 2001–02) over the 5-year period to 30 June 2007.* We aim to achieve this reduction without compromising our service levels, productivity, or staff comfort.

Energy use (megajoules) per fulltime staff equivalent

The electricity use for 2003–04 excludes the new site at Bream Bay and the upgrade to the supercomputer at Greta Point. The goal to reduce energy use was set before these facilities were established, and it is not currently possible to reduce their energy demands. Bream Bay is NIWA's newest facility, specialising in large-scale aquaculture production, and it accounted for 15.6% of the total electricity use for 2003–04. The change in electricity consumption in 2003–04 compared with the baseline in 2001–02 represents a decrease of 2%. The higher gas use is related to heating at NIWA's Greta Point site during a colder year. [The average temperature in New Zealand during 2003–04 was 12.5 °C, compared with 12.9 °C in 2001–02.]

In addition to auditing the use of electricity and gas for the New Zealand-based operations, we have gathered activity data on our use of motor vehicles, hire of taxis, and air travel to enable assessment of the greenhouse gas emissions produced by our activities. The consumption of fossil fuels to support our activities was estimated to have emitted 2983 tonnes of carbon dioxide in the year ending 30 June 2002, 3030 for 30 June 2003, and 3373 for 30 June 2004, using the protocol made available by the New Zealand Business Council for Sustainable Development. Use of motor vehicles, hire of taxis, and air travel are essential to our business. While we will continue to minimise travel where possible, our use of these resources is likely to increase in future as our business continues to grow. We will attempt to balance this through energy savings, so that *total annual contribution to greenhouse gas emissions for New Zealand-based operations, based on full-time staff equivalents, does not increase above the baseline level at 30 June 2002 in the 5-year period to 30 June 2007.*

Electricity is a significant resource used by NIWA. In 2003–04 it accounted for 69% of the total carbon dioxide emissions. NIWA's major resource use (%) was:



Based on full-time staff equivalents (586), the emission of carbon dioxide in 2003–04 was the same as that by full-time staff equivalents (580) in 2002–03. Carbon dioxide emissions (t) per full-time staff equivalent were:

An Inventory of New Zealand's Greenhouse Gas Emissions (http://www.niwa.co.nz/ncces/ghge) and the Residential Carbon Dioxide Calculator (http://www.niwa.co.nz/ncces/co2calc) were developed during the year and are both active on the NIWA website. The latter tool enables individuals to estimate their contribution to carbon dioxide emissions.

NIWA Vessel Management Limited

NIWA Vessel Management Limited manages two research vessels: *Tangaroa* (deepwater) and *Kaharoa* (inshore and coastal). Both vessels operate on diesel fuel, and the equivalent carbon dioxide emissions for the past three financial years were:

2002	6682 t (12.7 t per sea-day)
2003	6091 t (12.5 t per sea-day)
2004	5522 t (11.7 t per sea-day)

To ensure the level of emissions from diesel fuel is minimised, work-scheduling plans are continuously reviewed, and servicing and maintenance plans are constantly updated. Both vessels are classified with Det Norske Veritas (DnV), an internationally recognised classification society, and are maintained in accordance with the society's rules. These rules require that the vessels comply with stringent planned maintenance routines and high levels of operational practice (related to condition of machinery and equipment).

Waste management and recycling

During the past 12 months, NIWA has put in place a plan for waste management and recycling. This plan includes all staff having a paper recycling bin in their office, waste recycling bins for other items (e.g., plastics, cardboard, glass) in key areas at each NIWA site, using plastic milk containers for other uses, and increasing awareness to reduce waste and increase recycling. The quantities of solid waste products and recycled paper estimated for NIWA's four main sites (Auckland, Hamilton, Wellington, and Christchurch), based on the number of full-time staff at these sites (485), were:

Recycled paper: 21 700 kg (44 kg per FTE)

Solid waste: 72 700 kg (150 kg per FTE)

The goal over the next 5 years is to increase recycling of paper and reduce solid waste by at least 10%, based on the number of full-time staff. Our progress towards achieving this goal will be reported in subsequent annual reports.

There were no incidents of non-compliance with discharge regulations.

The waste management plans for NIWA's vessels follow those of the International Ship Management Code set by the International Maritime Organisation.

Paper use

Paper has been identified as the most significant area of waste for NIWA. We have implemented procedures to have all computers print double-sided as default, and only purchase printers and copiers that have a duplexing capability. These procedures include improving staff awareness (e.g., through newsletters and notices next to printers and photocopiers), and IT staff checking that computers have the double-sided printing default. Based on full-time staff, paper purchased during the year ended 30 June 2004 was 14.6 reams per full-time staff member, *and our goal is to reduce this by 10% over the next 5 years. Our progress towards achieving this goal will be reported in subsequent annual reports.*

Animal ethics committee

NIWA maintains a high regard for animal welfare. All research with live animals must be approved by our Animal Ethics Committee (AEC), in accordance with the Animal Welfare Act (1999).

Our AEC meets regularly and conducts some of its business by email. It ensures that all our animal-based research is conducted in accordance with NIWA's Code of Ethical Conduct for the Use of Live Animals in Research, which has ministerial approval as required by the Act. Animal use is reported annually to the Ministry of Agriculture and Forestry.

Our code of ethical conduct permits the use of animals only when the AEC considers that the benefits of the research outweigh any suffering imposed on the animals. Only the minimum number of animals needed to produce statistically sound results can be used. The total number of animals and the range of species used (mainly fish) depends entirely on the funded projects. Consequently, use varies from year to year.

NIWA's current Code of Ethical Conduct expires in December 2004. A new code was drafted and submitted to the Ministry of Agriculture and Forestry, after an independent review in May 2004 which assessed NIWA's compliance with the Animal Welfare Act.

The review also included an on-site examination of NIWA's Bream Bay Aquaculture Park, and found a high standard of compliance due to the thorough research planning, monitoring by the Animal Ethics Committee, and the high degree of expertise and professionalism among staff. The review has been accepted by MAF, who have now advised us that a satisfactory level of compliance has been achieved, and the new NIWA code will be considered by MAF in August 2004 for Ministerial approval.

During the year, NIWA entered into a partnering arrangement to allow Kelly Tarlton's Antarctic Encounter and Underwater World to use NIWA's Animal Ethics Committee as permitted under the Act. This further strengthens existing relationships with Kelly Tarlton's.

Social and cultural responsibility

Social responsibility starts with the well-being of NIWA staff. NIWA remains committed to providing a safe and healthy work environment and promoting a good work-life balance. To successfully achieve NIWA's objectives, there needs to be a close alignment with employee policies and practices and recognition that staff are NIWA's most significant resource.

NIWA has maintained its position as the leading CRI for non-financial benefits that enhance staff well-being, has continued its involvement in community programmes and education programmes at all levels from primary school to universities, and is committed to the principles of the Treaty of Waitangi.

NIWA as a good employer

NIWA recognises that staff are its biggest asset, and is committed to providing a safe and healthy working environment that enhances professional or career development, promotes work-life balance, rewards staff within the financial constraints of the company, and promotes innovation and excellence in scientific research, commercial services, and the commercialisation of intellectual property.

The facilitation of innovative, leading edge science and the enhancement of careers are major objectives of management and are essential if we are to retain and recruit top staff. Steps taken during 2003–04 included the continued strong investment in new capital equipment and overseas travel, a review of scientific and administrative workloads, a revision of the project management system to better manage projects, staff being encouraged to take leave, training sessions on communication and staff management, and the development of new key roles to spread the workload more evenly and increase opportunities for staff to develop their careers by taking on new responsibilities. A staff satisfaction survey is carried out every 3 years, with the next one planned for 2004–05.

Staff benefits and entitlements

The terms and conditions of employment for staff are specified in our collective employment agreement and individual employment agreements. The collective agreement negotiated with the Public Service Association (PSA) expired on 1 July 2004, and negotiations are under way for a new collective agreement. NIWA continues to maintain an excellent working relationship with the PSA, and the PSA Partnership Forum is now a well-established process for sharing information with the union on key issues affecting staff. Membership of the PSA is voluntary, and 53% of staff are currently members. In addition to participation in the PSA Partnership Forum, members benefit from a health care subsidy.

Benefits available to all permanent staff include an annual review of remuneration, a profit-share scheme, competitive salaries, employer superannuation contributions (dollar for dollar up to 5% of salary), provision of life insurance, 4 weeks' leave after 3 years' continuous service, sick and bereavement leave as required, long service leave after 20 years, parental leave of up to 12 months with payment of up to 6 weeks, training leave of 3 days (accumulated to 15 days), NSOF-supported sabbaticals, technical training awards and postdoctoral grants, and access to group healthcare schemes. These benefits reflect NIWA's strong commitment to fair and equitable treatment of staff.

Rewarding staff

NIWA's performance management system includes a remuneration policy that pays for the range, depth, and type of skills of our staff. In addition, we have a profit-share scheme which allows for the distribution to all staff of a proportion of NIWA's post-tax operating surplus when this exceeds our profit target for the year. Although revenue is not growing, our tight control on expenses and increased productivity has allowed us to keep staff remuneration ahead of the market median based on Hay surveys. It is difficult to make comparisons between organisations, but NIWA needs highly qualified and experienced staff at all levels of the organisation, which is reflected in the higher salaries compared with market medians.

Health & safety

NIWA continued to make solid progress towards the excellent management of health and safety. Our participation in the ACC partnership programme was continued in 2003–04. We were again accepted into the programme at secondary level in recognition of our safety management practices. NIWA was noted this year as having a comprehensive integrated system of hazard management, an excellent employee participation scheme, and a strong planning and reporting cycle. Commitment to rehabilitation, and an alternative duties provision, maintained the extremely low number of days lost due to workplace accidents. This was less than 0.005% of total work days per annum for NIWA Science staff, and resulted from only one accident. There were no lost days due to accidents for the Vessel Company. This is a significant improvement on previous years and reflects our comprehensive health and safety practices.

The number of work days lost by NIWA Science because of workplace accidents was:

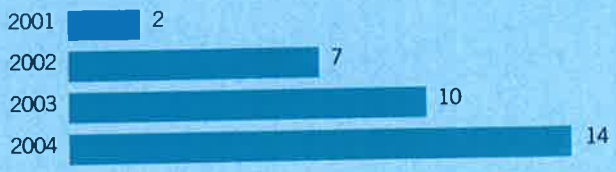
NIWA has a comprehensive health and safety plan which addresses health and safety issues and identifies actions and responsibilities required for legislation and other statutory responsibilities. A number of water safety and sea survival training courses were run during the year, and new safe ship management manuals were produced for all NIWA boats, meaning we are now compliant with the new Maritime Safety Authority regulations. NIWA helped develop The Exempt Laboratories Code of Practice in conjunction with other CRIs and the universities, and this was finally approved in June. NIWA's procedures and responsibilities have been revised to ensure compliance with the new code.

Working with Māori

NIWA is committed to building strong relationships with Māori through the continued development of collaborative research partnerships at 'flaxroots' level with iwi, hapu, and Māori organisations. Our Māori Research and Development Unit, Te Kūwaha, is working mainly on research that underpins Māori aspirations for business development and sustainable resource management. Our Māori researchers and scientists specialise in three core areas: climate and energy, freshwater research, and marine and aquaculture research. A key objective for Te Kūwaha is to raise awareness for the Māori tikanga within NIWA to improve our interactions with Māori and thus make NIWA an attractive place for Māori researchers to work. Te Kūwaha comprises a General Manager with 13 key Māori scientists and technicians.

We have daily interaction with iwi, and currently have 48 iwi relationships, including 18 non-formal arrangements, 9 interested parties, 11 draft proposals, and 10 signed memorandums of understanding.

Number of staff in Te Kūwaha



Benefits to New Zealand and international obligations

NIWA has continued to make its expertise available to Government departments and to meet New Zealand's international obligations. This commitment is described in more detail in other sections of this report.

Benefits to New Zealand: education

NIWA continues its strong commitment to the advancement of science education and knowledge in schools and universities, and to the wider public. NIWA is a major sponsor of the Auckland, Waikato, Bay of Plenty, Wellington, and Nelson regional school science fairs, and sponsors the marine education facility at Kelly Tarlton's Underwater World. NIWA has strong links with New Zealand universities; for example, through the joint NIWA-University of Auckland Institute of Aquatic and Atmospheric Sciences and the postgraduate Centres of Excellence with Victoria University of Wellington, the University of Canterbury, and the University of Otago. NIWA supervised 68 postgraduate students (54 at PhD level), provided 4 PhD scholarships, offered 13 sponsored and self-funded environmental management and biodiversity training courses, and provided funding for 15 postdoctoral fellowships. Additional details are provided in 'Education and Training' on page 29 of this annual report.

Verification statement

Scope and methodology

URS New Zealand has carried out an independent audit of the National Institute of Water and Atmospheric Research (NIWA) Sustainable Development Report for 2004 – a section of the Annual Report for 2004 – to provide assurance to readers on the accuracy of the report's content and to provide guidance on appropriateness and completeness of reporting.

The audit methodology was drawn from the AA1000 Assurance Standard (March 2003) – an international standard developed to ensure the credibility of an organisation's public reporting on social, economic, and environmental performance. Specifically, the audit was designed to investigate the 'Evidence' – whether NIWA has provided adequate evidence to support the information contained in the report. The AA1000 principles of completeness, materiality, and responsiveness guided feedback on enhancements to the current and future reports.

The audit methodology was to:

- Review the draft Sustainable Development Report for 2004 – to identify statements of fact/claims and data requiring verification.
- Conduct interviews with key personnel at the NIWA Auckland and Wellington offices.
- Sight specific documented information, computer, and hard-copy files, data sources, and data.
- Identify errors or weakness in data, provide feedback to NIWA, and verify the final report.

The complete contents of the Sustainable Development Report for 2004 were verified with the exception of 2004 Total Revenue, Operating Surplus before Tax, Return on Equity, and Taxes Paid (audited by Deloitte).

Independence

There is no aspect of the relationship between URS New Zealand and NIWA that has influenced the independent nature of these verification findings. URS New Zealand has collaborated with NIWA on hydrological investigations and other projects.

Findings

On the basis of the described audit methodology, URS New Zealand Limited verifies that the content of the NIWA Sustainable Development Report for 2004 provides an accurate description of the company's environmental, social, and economic performance.

Comments/Recommendations

NIWA's commitment to all aspects of performance – financial results, economic impacts, health and safety, being a good employer, minimising environmental impact, and contributing positively to the community – was evident through the verification process.

This commitment is reflected through a good range of clear intentions to sustainability, some of which are expressed as specific goals, and the continued development of benchmarking data and progress reported towards goals.

There is, however, scope for expanding goals and highlighting them through effective presentation. Establishing social and economic goals, some of which are implied in NIWA's Business Plan, is an important next step. Coverage of governance responsibilities in achieving sustainability targets, particularly of executive-level staff, also gives greater credibility to strategies and identifies accountability. Improving management systems and formal processes for the collection of benchmarking data would also help to ensure consistent reporting and the process of verification.

The 2004 report incorporates excellent material that focuses on sustainability initiatives undertaken as part of NIWA's core work. Commentary on future work in this area would add value to the report.

We commend NIWA on their 2004 Sustainable Development Report and look forward to future reports reflecting improved performance and further commitments to sustainable development.

URS New Zealand Limited
20 August 2004

Kerry Griffths
Senior Sustainability Consultant

NIWA Board: (left to right) Troy Newton, Sue Suckling, David Sharp, Miranda Cassidy, John Hercus, John Spencer, Carolyn Burns. Inset: Graham Hill.

Directors' profiles

Sue Suckling *(Chair)*, OBE, BTech (Hons), MTech, is a Christchurch-based director and consultant. She is Chair of Agriquality New Zealand Ltd and a director of several other private companies, including WestpacTrust Investments Ltd. Previously, she was Deputy Chair of the Institute of Geological & Nuclear Sciences Ltd. Sue Suckling was appointed NIWA Chair in July 2001.

Professor Carolyn Burns is Head of the Department of Zoology at the University of Otago and a distinguished limnologist. She holds a doctorate from the University of Toronto, was awarded the CBE in 1984, and is a Fellow of the Royal Society of New Zealand. She has held visiting research professorships in US universities and was a research scientist at the Max-Planck Institute for Limnology. In 1999 she was honoured with the University of Canterbury Distinguished Alumni Award.

Miranda Cassidy, BA in sociology, MSc (Hons) in resource management, is an Auckland-based company director and consultant. She is a former customary fisheries manager of Ngai Tahu Development Corporation and is currently director of FOLKUS Ltd, an environmental consulting company.

John Hercus has an MSc in physics from Victoria University of Wellington and has been a leading figure in polytechnic, technology, and science education, serving as Director of the Christchurch Polytechnic from 1974 to 1993. He has worked for the UN Development Programme in higher education and training, and on projects with UNESCO and the Asian Development Bank. He has held directorates with several companies involved in international education and technology development

Dr Graham Hill is an astronomer and astrophysicist currently lecturing at the University of Auckland and the Auckland University of Technology. From 1967 to 1996 he was a research scientist at the National Research Council of Canada – Dominion Astrophysical Observatory in Victoria, BC, and is a scientific computer software consultant for several overseas universities. He is an invited member of the International Astronomical Union and holds a PhD in astronomy from the University of Texas, an MA from the University of Minnesota, and a BSc from the University of Auckland. He is a Director of the Meteorological Service of New Zealand.

Troy Newton is a Director of KPMG Corporate Finance, where he advises clients on mergers and acquisitions, valuation, regulatory reform, and financing matters in New Zealand, Australia, and the Pacific Rim. He is a chartered accountant and was a Director of Industrial Research Limited from 1997 until September 2002. He has particular industry experience in telecommunications, information technology, and energy and transport operations.

David Sharp, BSc, is Chairman of the New Zealand Seafood Industry Council, and holds a number of other positions in the seafood industry. He was previously executive director of a major New Zealand primary produce exporting and seafood company.

John Spencer is the Chairman of Tainui Group Holdings Ltd and a Director of Tower Ltd and Triage Capital Ltd. He was the Chief Executive of New Zealand Dairy Group prior to the formation of Fonterra, and he has held a number of senior management positions in New Zealand and overseas. A Fellow of the Institute of Chartered Accountants, he is Deputy Chairman of the Accounting Standards Review Board and a trustee of Workbase, the national centre for literacy.

The Directors take pleasure in presenting the National Institute of Water & Atmospheric Research Ltd (NIWA) and Group Annual Report for the financial year ended 30 June 2004.

Business activities

The NIWA Group provided scientific research and consultancy services in New Zealand and overseas during the financial year. In New Zealand, services were provided to the Foundation for Research, Science & Technology, the Ministry of Fisheries, and a range of other public and private sector customers. Internationally, services were provided by NIWA and its subsidiaries to public and private sector customers in the USA and Australia.

Results

This financial year the NIWA Group has exceeded its Business Plan objectives with a net surplus of $5.3 million (2003: $4.7 million) against a budgeted net surplus of $2.9 million. This was achieved on a turnover of $84.6 million (2003: $84.2 million), against budgeted revenue of $85.1 million.

Shareholders' equity at 30 June 2004 totalled $51.9 million (2003: $46.7 million), an increase of 11.1%. Total assets increased 8.4% to $72.3 million (2003: $66.7 million).

Donations

No donations were made during the year.

Dividends

No dividend was paid during the year.

Directors

There were no changes in Directors holding office during the financial year.

Remuneration of Directors

Directors' remuneration received, or due and receivable during the year, is as follows:

	Parent	
	2004 $'000	2003 $'000
Directors of the National Institute of Water & Atmospheric Research Ltd		
S H Suckling (Chair)	52	42
C W Burns	26	21
M K Cassidy	26	21
J D Hercus	26	21
G Hill	26	21
T W Newton	30	27
D C Sharp	26	21
New appointees during the 30 June 2003 year		
J Spencer	30	–
Directors of NIWA Australia Pty Ltd		
P Twynham	1	1

No fees were paid in respect of Directors of the subsidiaries NIWA Vessel Management Ltd, NIWA Environmental Research Institute, NIWA (USA), Incorporated, NIWA Australia Pty Ltd, NIWA Natural Solutions Ltd, and Unidata Pty Ltd, other than those shown above.

Remuneration of employees

The numbers of employees (not including Directors) whose total remuneration exceeded $100,000 is as follows:

	Group	
$	**2004**	2003
100,000–109,999	11	8
110,000–119,999	16	10
120,000–129,999*	1	3
130,000–139,999	3	2
140,000–149,999*	1	3
150,000–159,999*	4	5
160,000–169,999	1	1
170,000–179,999	2	2
180,000–189,999	–	1
190,000–199,999*	1	1
280,000–289,999**	–	1
290,000–299,999**	1	–

** Includes individuals who received redundancy packages in 2003.*

*** Chief Executive Officer's remuneration band.*

The redundancy provisions, which include retirement leave and severance, were calculated in accordance with Clause 31 of the NIWA Collective Employment Agreement in force from 1 July 2001 to 1 July 2004.

Auditors

In accordance with Section 21(1) of the Crown Research Institutes Act 1992, the auditors, Deloitte on behalf of the Auditor-General, continue in office. Their audit remuneration and fees paid for other services are detailed in note 4 of the 'Notes to the Group Financial Statements'.

Interests Register

The following are transactions recorded in the Interests Register for the year.

(a) Parent and subsidiary companies

Interested transactions
Any business the NIWA Group has transacted with organisations in which a director has an interest has been carried out on a commercial 'arms-length' basis.

Directors' remuneration
Details of the Directors' remuneration are provided in the Remuneration of Directors section.

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.

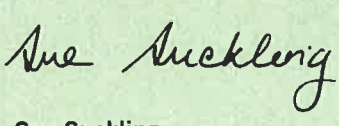
Share dealings
During the year no Directors purchased or disposed of any equity securities of the NIWA Group.

Directors' loans
There were no loans by the NIWA Group to any Directors.

Directors' insurance
The NIWA Group has arranged policies for Director's Liability Insurance which, with a Deed of Indemnity, ensures that generally Directors will incur no monetary loss as a result of actions undertaken by them as Directors. Certain actions are specifically excluded; for example, the incurring of penalties and fines which may be imposed in respect of breaches of the law.

The Directors are pleased with the state of affairs of the NIWA Group.

For and on behalf of the Board:



Sue Suckling
Chair
25 August 2004

Troy Newton
Director

Corporate Governance Statement

Board of Directors

The Board of Directors of the National Institute of Water & Atmospheric Research Ltd (NIWA) is appointed by the shareholding Ministers to guide and monitor the business of NIWA and its subsidiaries NIWA Vessel Management Ltd, NIWA Environmental Research Institute, NIWA (USA), Incorporated, NIWA Australia Pty Ltd, NIWA Natural Solutions Ltd, and Unidata Pty Ltd, which constitute the NIWA Group.

The Board comprised up to eight Directors (including the Chair) during the financial year ended 30 June 2004 and formally met twelve times during that period.

Responsibility for the management and administration of the Group is delegated to the Chief Executive Officer, who is responsible to the Board.

Audit and Legislative Compliance Committee

The Audit and Legislative Compliance Committee is a sub-committee of the Board. During the financial year, the Audit and Legislative Compliance Committee comprised three members of the Board and met formally three times with the NIWA Chair as an ex-officio member. All Board members were members of the Audit and Legislative Compliance Committee up to 27 August 2003.

The function of the Audit and Legislative Compliance Committee is to assist the Board in carrying out its responsibilities under the Crown Research Institutes Act 1992, the Public Finance Act 1989, the Companies Act 1993, and the Financial Reporting Act 1993 in respect of the Group financial accounting practices, policies, and controls and to review and make appropriate enquiry into the audits of the Group Financial Statements by both internal and external auditors.

Remuneration Committee

The Remuneration Committee is a sub-committee of the Board and consists of two members, the NIWA Chair and the Chair of the Audit and Legislative Compliance Committee.

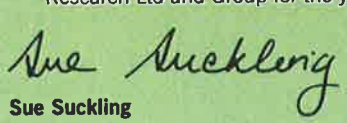
The Remuneration Committee reviews the remuneration policies applicable to the Chief Executive Officer on an annual basis and makes recommendations on remuneration packages and terms of employment to the Board. The Remuneration Committee also ratifies the remuneration packages of the direct reports to the Chief Executive Officer.

Remuneration packages are reviewed with due regard to performance and other relevant factors.

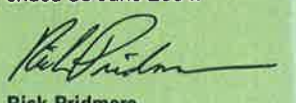
Statement of Management Responsibility

The following statement is made in accordance with Section 42 of the Public Finance Act (1989):

1. The management of the company is responsible for the preparation of these Financial Statements and the judgements used therein.
2. The management of the company is responsible for establishing and maintaining internal control procedures designed to provide reasonable assurance as to the integrity and reliability of financial reporting.
3. In the opinion of management, these Financial Statements fairly reflect the financial performance, movements in equity, financial position, and cash flows of the National Institute of Water & Atmospheric Research Ltd and Group for the year ended 30 June 2004.



Sue Suckling
Chair
25 August 2004



Rick Pridmore
Chief Executive

National Institute of Water & Atmospheric Research Ltd and Group

Statement of Financial Performance

for the year ended 30 June 2004

	Note	Group 2004 Actual $'000	Group 2004 Budget $'000	Group 2003 Actual $'000	Parent 2004 Actual $'000	Parent 2003 Actual $'000
Revenue	3	84,631	85,068	84,200	83,396	82,090
Operating surplus before taxation	4	**7,036**	**4,208**	**7,216**	**5,398**	**5,688**
Taxation expense	5a	1,760	1,331	2,490	1,751	1,916
Net surplus		**5,276**	**2,877**	**4,726**	**3,647**	**3,772**
Net surplus comprises:						
Parent interest		5,280	2,877	4,726		
Minority interest	8	(4)	–	–		
		5,276	**2,877**	**4,726**		

The accompanying 'Notes to the Financial Statements' are an integral part of, and should be read in conjunction with, this 'Statement of Financial Performance'.

National Institute of Water & Atmospheric Research Ltd and Group

Statement of Movements in Equity

for the year ended 30 June 2004

	Note	Group 2004 Actual $'000	Group 2004 Budget $'000	Group 2003 Actual $'000	Parent 2004 Actual $'000	Parent 2003 Actual $'000
Net surplus for the year:						
Parent		5,280	2,877	4,726	3,647	3,772
Minority interests		(4)	–	–	–	–
Foreign currency translation reserve movement	6b	(113)	–	(128)	–	–
Total recognised revenues and expenses		**5,163**	**2,877**	**4,598**	**3,647**	**3,772**
Acquisition of subsidiary	8	68	–	–	–	–
Movements in minority interests		**68**	**–**	**–**	**–**	**–**
Movements in equity for the year		**5,231**	**2,877**	**4,598**	**3,647**	**3,772**
Equity at the beginning of the year		**46,713**	**47,964**	**42,115**	**37,723**	**33,951**
Equity at the end of the year		**51,944**	**50,841**	**46,713**	**41,370**	**37,723**

The accompanying 'Notes to the Financial Statements' are an integral part of, and should be read in conjunction with, this 'Statement of Movements in Equity'.

Statement of Financial Position

as at 30 June 2004

	Note	**Group 2004 Actual $'000**	Group 2004 Budget $'000	Group 2003 Actual $'000	**Parent 2004 Actual $'000**	Parent 2003 Actual $'000
Equity						
Share capital	6a	24,799	24,799	24,799	24,799	24,799
Equity reserves	6b	27,081	26,042	21,914	16,571	12,924
Shareholders' interest		51,880	50,841	46,713	41,370	37,723
Minority shareholders' interest	8	64	–	–	–	–
Total equity		**51,944**	**50,841**	**46,713**	**41,370**	**37,723**
Non-current liabilities						
Unsecured loans	9	424	–	–	–	–
Employee entitlements	10	1,752	2,118	1,960	1,676	1,881
Intercompany	21	–	–	–	8,015	7,631
Total non-current liabilities		**2,176**	**2,118**	**1,960**	**9,691**	**9,512**
Current liabilities						
Payables and accruals	11	13,339	6,506	10,742	12,963	9,679
Redundancy provision	12	–	–	571	–	571
Short-term advance facility	13	–	–	600	–	600
Employee entitlements	10	4,825	3,180	6,092	4,582	5,891
Total current liabilities		**18,164**	**9,686**	**18,005**	**17,545**	**16,741**
Total equity and liabilities		**72,284**	**62,645**	**66,678**	**68,606**	**63,976**
Non-current assets						
Property, plant, & equipment	14	45,174	46,757	46,393	30,909	30,989
Identifiable intangibles	16	68	–	–	–	–
Investments in subsidiaries	20	–	–	–	12,709	12,421
Future income taxation benefit	5b	979	763	1,322	3,218	3,580
Receivables and prepayments	17	547	–	–	547	–
Total non-current assets		**46,768**	**47,520**	**47,715**	**47,383**	**46,990**
Current assets						
Cash and short-term deposits		5,195	4,617	1,126	4,600	819
Receivables and prepayments	17	15,022	7,748	14,515	13,123	14,033
Taxation receivable		791	(500)	702	525	161
Contract work in progress		2,422	2,210	1,534	2,161	1,298
Inventories	18	2,086	1,050	1,086	814	675
Total current assets		**25,516**	**15,125**	**18,963**	**21,223**	**16,986**
Total assets		**72,284**	**62,645**	**66,678**	**68,606**	**63,976**

For and on behalf of the Board:

Sue Suckling
Chair
25 August 2004

Troy Newton
Director

The accompanying 'Notes to the Financial Statements' are an integral part of, and should be read in conjunction with, this 'Statement of Financial Position'.

Statement of Cash Flows

for the year ended 30 June 2004

	Note	Group 2004 Actual $'000	Group 2004 Budget $'000	Group 2003 Actual $'000	Parent 2004 Actual $'000	Parent 2003 Actual $'000
Cash flows from operating activities						
Cash was provided from:						
Receipts from customers		85,580	84,878	80,354	86,234	79,030
Interest received		242	34	132	241	105
		85,822	84,912	80,486	86,475	79,135
Cash was disbursed to:						
Payments to employees and suppliers		(71,904)	(70,992)	(64,222)	(73,169)	(66,725)
Interest paid		(14)	(30)	(173)	(7)	(173)
Taxation paid		(1,506)	(1,269)	(3,297)	(1,752)	(2,641)
		(73,424)	(72,291)	(67,692)	(74,928)	(69,539)
Net cash inflow from operating activities	19	**12,398**	**12,621**	**12,794**	**11,547**	**9,596**
Cash flows from investing activities						
Cash was provided from:						
Sale of property, plant, & equipment		168	300	209	169	209
Loans advanced from subsidiary company		–	–	–	384	2,494
Cash was applied to:						
Purchase of property, plant, & equipment		(8,389)	(8,170)	(9,064)	(7,431)	(8,243)
Investment in subsidiary		–	–	–	(288)	–
Net cash outflow in investing activities		**(8,221)**	**(7,870)**	**(8,855)**	**(7,166)**	**(5,540)**
Cash flows from financing activities						
Cash was applied to:						
Issue of equity share capital to minority shareholders	8	68	–	–	–	–
Unsecured loan received	9	424	–	–	–	–
Repayment of short-term advance facility		(600)	(1,500)	(3,700)	(600)	(3,700)
Net cash outflow from financing activities		**(108)**	**(1,500)**	**(3,700)**	**(600)**	**(3,700)**
Net increase in cash held		**4,069**	**3,251**	**239**	**3,781**	**356**
Add opening cash balance		1,126	1,366	887	819	463
Closing cash balance		**5,195**	**4,617**	**1,126**	**4,600**	**819**
Made up of:						
Cash		1,638	4,617	1,118	1,050	819
Short-term deposits		3,557	–	8	3,550	–
Closing cash balance		**5,195**	**4,617**	**1,126**	**4,600**	**819**

The accompanying 'Notes to the Financial Statements' are an integral part of, and should be read in conjunction with, this 'Statement of Cash Flows'.

Notes to the Financial Statements

for the year ended 30 June 2004

1 Nature of activities

The National Institute of Water & Atmospheric Research Ltd (NIWA) and Group conducts research in water and atmospheric sciences in New Zealand and internationally.

2 Statement of accounting policies

The NIWA Financial Statements and Group Financial Statements are presented in accordance with the requirements of the Crown Research Institutes Act 1992, the Public Finance Act 1989, the Companies Act 1993, and the Financial Reporting Act 1993. The NIWA Financial Statements are for the Parent Company as a separate entity. The consolidated (or 'Group') Financial Statements comprise NIWA (the 'Parent company'), its subsidiaries, and the Group's interest in associates and joint ventures.

Measurement base

The Financial Statements have been prepared in accordance with Generally Accepted Accounting Practice (GAAP) in New Zealand. The measurement and reporting of financial performance, movements in equity, financial position, and cash flows is based on historical cost. The reporting currency used in the preparation of these Financial Statements is New Zealand dollars.

Specific accounting policies

The following specific accounting policies, which materially affect the measurement of financial performance, movements in equity, financial position, and cash flows, have been established and consistently applied.

(a) Basis of consolidation

i) Consolidation of subsidiaries

Subsidiaries are those entities controlled by NIWA. The Group Financial Statements have been prepared using the purchase method of consolidation. This involves adding corresponding assets, liabilities, revenues, and expenses on a line-by-line basis. All intercompany transactions, balances, and unrealised profits are eliminated on consolidation. The results of any subsidiaries that become or cease to be part of the Group during the year are consolidated from the date that control commenced or until the date that control ceased.

The interest of minority shareholders is stated at the minority's proportion of the fair values of the identifiable assets and liabilities recognised on acquisition together with the minority interests' share of post acquisition surpluses.

ii) Accounting for joint ventures

Joint ventures are joint arrangements between NIWA and another party in which there is a contractual agreement to undertake a specific business project in which the venturers share several liabilities in respect of the costs and liabilities of the project and share in any resulting output. NIWA's share of the assets, liabilities, revenues, and expenses of the joint ventures are incorporated into the Parent Company and Group Financial Statements on a line-by-line basis using the proportionate method.

(b) Revenue recognition

Contract revenue is recognised based on the lower of the stage of completion of the contract or the value of work done. The amount of revenue unbilled is represented by 'Contract work in progress' in the Statement of Financial Position. Revenue received but not earned is recognised as revenue in advance in 'Payables and accruals' in the Statement of Financial Position.

(c) Goods and Services Tax (GST)

These Financial Statements are prepared on a GST-exclusive basis, except for receivables and payables, which are stated with GST included.

(d) Taxation

Taxation expense is charged in the Statement of Financial Performance in respect of the current year's operating surplus after allowing for permanent differences. The provision for taxation for the year includes both current and deferred tax on income after taking into account all available deductions.

Deferred tax arising from timing differences in recognition of income and expenditure for tax purposes has been accounted for using the liability method on a comprehensive basis. A debit balance in the deferred tax account (hereafter called 'future income taxation benefit'), arising from timing differences or taxation benefits from taxation losses, is recognised only if there is virtual certainty of realisation.

(e) Identifiable intangible assets

Purchased identifiable intangible assets, comprising copyrights and trademarks, are recognised at cost and amortised in the statement of financial performance on a straight line basis over their estimated useful lives. When the carrying amount of an identifiable intangible asset exceeds its recoverable amount, it is written down to its recoverable amount.

(f) Development costs

Development costs that meet the following criteria are recognised as an asset in the Statement of Financial Position:

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

Capitalisation is limited to the amount which, taken together with further related costs, is probable of recovery from related future economic benefits.

When the criteria above no longer apply, the unamortised balance of development costs is written off and recognised immediately as an expense.

Development costs recognised as an asset are amortised in the Statement of Financial Performance on a straight-line basis over the period of expected benefits.

When the unamortised balance of development costs exceeds the amount probable of future recovery from related future economic benefits less related future costs, the excess is written down and recognised immediately as an expense.

(g) Investments

Non-current investments are valued at cost. Where the carrying amount of an investment exceeds its recoverable amount it is written down to its recoverable amount.

(h) Property, plant, and equipment

Property, plant, and equipment, except land, are valued at historical cost less accumulated depreciation to date. Land is valued at cost. Property, plant, and equipment purchased from the Crown at 1 July 1992 and 1 July 1995 are stated at the transfer price at those dates, adjusted for subsequent disposals and depreciation.

Property, plant, and equipment with a cost price less than $2,000 and computer software are fully depreciated in the year of purchase.

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

(i) Depreciation

Property, plant, and equipment, except for freehold land, are depreciated on a straight-line basis at rates estimated to write off the cost (or transfer price) of the property, plant, and equipment over their estimated useful lives. Maximum useful lives used are as follows:

RV *Tangaroa* hull	26 years
RV *Kaharoa* hull	16 years
Small boats	5 years
Buildings	40 years
Leasehold improvements, freehold property	10 years
Leasehold improvements, rented property	5 years
Supercomputer	5 years
Scientific equipment	4 years
Plant & equipment	10 years
Other electronic data processing equipment	3 years
Furniture & fittings	10 years
Office equipment	5 years
Motor vehicles	4 years

(j) Receivables

Receivables are stated at their estimated realisable value after providing for doubtful and uncollectable debts.

(k) Inventory

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

(l) Foreign currencies

i) Transactions

Transactions in foreign currencies are converted at the New Zealand rate of exchange ruling on the date of the transaction. Monetary assets and liabilities are converted to the New Zealand rate of exchange ruling at balance date, and any exchange gains or losses are taken to the Statement of Financial Performance.

ii) Translation of independent foreign operations

Revenues and expenses of independent foreign operations are translated to New Zealand dollars at the exchange rates in effect at the time of the transactions, or at rates approximating them. 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 independent foreign operations are recognised in the foreign currency translation reserve.

(m) Leases

The Group has not contracted for any leases which would be classified as finance leases.

Operating lease payments are recognised evenly over the expected period of benefit to the Group.

(n) Statement of cash flows

The statement of cash flows is prepared exclusive of GST, which is consistent with the method used in the Statement of Financial Performance. Operating activities comprise the provision of research services, consultancy, and manufacture of scientific instruments. Investing activities comprise the purchase and disposal of property, plant, and equipment and advances to subsidiaries. Financing activities are those which result in changes in the size and composition of the capital structure of the Group.

(o) Provision for dividends

Dividends are recognised in the year that they are authorised and approved.

(p) Changes in accounting policies

There have been no changes in accounting policies this year.

3 Revenue

	Group 2004 Actual $'000	Group 2004 Budget $'000	Group 2003 Actual $'000	**Parent 2004 Actual $'000**	Parent 2003 Actual $'000
Public Good Science and Technology					
– Contract funding	35,881	36,000	36,024	35,881	36,024
– Non-specific output funding (NSOF)	3,710	3,600	3,756	3,710	3,756
Ministry of Fisheries	14,602	17,774	16,705	14,602	16,705
Commercial	30,196	27,660	27,584	28,962	25,500
Interest income	242	34	131	241	105
	84,631	**85,068**	**84,200**	**83,396**	**82,090**

All revenue was derived from continuing activities.

4 Operating surplus before taxation

	Group 2004 Actual $'000	Group 2003 Actual $'000	**Parent 2004 Actual $'000**	Parent 2003 Actual $'000
The operating surplus before taxation is stated after charging/(crediting):				
Depreciation	9,533	9,548	7,508	7,665
Rental and operating lease costs	1,141	949	1,085	909
Remuneration of Directors	237	174	237	174
Net gain on sale of property, plant, & equipment	(166)	(136)	(166)	(136)
Bad debts written off	8	3	8	2
Net realised foreign currency gain	(27)	(148)	(33)	(150)
Interest expense	14	173	7	173
Remuneration of the auditors of these Financial Statements:				
– Audit fees	58	61	55	54
– Other services	22	48	22	12

4a. Depreciation

Buildings & improvements	1,255	1,190	1,232	1,166
Vessels	758	758	–	–
Plant & equipment	4,348	4,324	3,341	3,367
Electronic data processing equipment	1,876	1,984	1,748	1,939
Office equipment	537	599	528	589
Furniture & fittings	87	84	49	46
Motor vehicles	532	467	511	454
Small boats	140	142	99	104
Total	**9,533**	**9,548**	**7,508**	**7,665**

5 Taxation

		Group 2004 Actual $'000	Group 2003 Actual $'000	Parent 2004 Actual $'000	Parent 2003 Actual $'000
5a.	**Taxation expense**				
	Operating surplus before taxation	**7,036**	**7,216**	**5,398**	**5,688**
	Prima facie tax @ 33%	2,322	2,381	1,781	1,877
	Add/(less) tax effect of permanent differences	20	19	20	19
	Adjustment for tax losses not recognised	–	69	–	–
	Tax losses recognised	(279)	–	–	–
	Under/(over) provision in previous year	(303)	21	(50)	20
	Income taxation expense	**1,760**	**2,490**	**1,751**	**1,916**
	The income taxation expense is represented by:				
	– Current taxation	1,417	3,045	1,389	2,539
	– Deferred taxation/(Future income taxation benefit)	343	(555)	362	(623)
		1,760	**2,490**	**1,751**	**1,916**
5b.	**Future Income Taxation Benefit**				
	Balance at the beginning of the year	1,322	767	3,580	2,957
	Prior period adjustment	2	3	(62)	2
	Current year movement	(345)	552	(300)	621
	Balance at the end of the year	**979**	**1,322**	**3,218**	**3,580**
5c.	**Taxation losses**				
	Unrecognised taxation losses available for set-off against future assessable income:				
	– Taxation losses	–	236	–	–
	– Taxation savings thereon	–	78	–	–

NIWA Vessel Management Limited applied tax losses of $1,586,792 against its taxable income for the year ended 30 June 2003. These losses were incurred by subsidiary group entities in foreign taxation jurisdictions. No further losses are available to be carried forward and offset against future taxable income.

6 Equity

6a.	**Share capital**				
	Issued and fully-paid capital				
	24,798,700 shares	**24,799**	**24,799**	**24,799**	**24,799**
	All shares carry equal voting and distribution rights.				
6b.	**Equity reserves**				
	Equity reserves include:				
	Retained earnings	27,329	22,049	16,571	12,924
	Foreign currency translation reserve	(248)	(135)	–	–
	Total equity reserves	**27,081**	**21,914**	**16,571**	**12,924**
	Movements in reserves during the year were as follows:				
	Retained earnings				
	Balance at the beginning of the year	22,049	17,323	12,924	9,152
	add net surplus	5,280	4,726	3,647	3,772
	Balance at the end of the year	**27,329**	**22,049**	**16,571**	**12,924**
	Foreign currency translation reserve				
	Balance at the beginning of the year	(135)	(7)	–	–
	add foreign exchange loss on translation of independent foreign operations	(113)	(128)	–	–
	Balance at the end of the year	**(248)**	**(135)**	**–**	**–**

Foreign currency translation occurs as a result of the incorporation of the net assets of the international subsidiaries into the Group Financial Statements. The international subsidiaries are NIWA (USA), Incorporated, NIWA Environmental Research Institute, NIWA Australia Pty Ltd, and Unidata Pty Ltd (note 20).

7 Dividend payments

Consistent with the 2003 Crown Research Institute operating framework, no dividend payment was made during the current financial year.

8 Minority shareholders' interest

	Group 2004 Actual $'000	Group 2003 Actual $'000	Parent 2004 Actual $'000	Parent 2003 Actual $'000
Balance at the beginning of the year	–	–	–	–
Increase due to acquisition of subsidiary	68	–	–	–
Share of loss for the year	(4)	–	–	–
Balance at the end of the year	**64**	–	–	–

9 Unsecured loan

	424	–	–	–

The loan is unsecured and relates to a vendor finance agreement on the acquisition of a subsidiary, Unidata Pty Ltd. The loan is not subject to any interest and is payable when, and in such amounts, as the cashflow and the profitability of Unidata Pty Ltd permit from time to time. The loan is repayable on 7 May 2014.

10 Provision for employee entitlements

Balance at beginning of year	8,052	8,006	7,772	7,692
Additional provision recognised	4,167	5,392	3,847	5,133
Amount utilised	(5,642)	(5,346)	(5,361)	(5,053)
Balance at end of year	**6,577**	**8,052**	**6,258**	**7,772**
Classified as follows:				
Non-current	**1,752**	**1,960**	**1,676**	**1,881**
Current	**4,825**	**6,092**	**4,582**	**5,891**

The provision for employee entitlements relates to employee benefits such as accrued wages, holiday pay, long service, and retirement leave. The provision is affected by a number of estimates, including the expected employment period of employees and the timing of employees using the benefits.

11 Payables and accruals

Trade payables	7,458	6,372	7,082	5,914
Revenue in advance	5,881	4,370	5,881	3,765
Total	**13,339**	**10,742**	**12,963**	**9,679**

12 Redundancy provision

Balance at the beginning of the year	571	–	571	–
Additional redundancy provision made	–	571	–	571
Amount utilised	(571)	–	(571)	–
Balance at the end of the year	–	**571**	–	**571**

The redundancy provision relates to employee redundancies and was fully utilised in 2004.

13 Short-term advance facility

A short-term advance facility is available from The National Bank of New Zealand Limited.

Advance facility	–	**600**	–	**600**

The facility is unsecured, but subject to various covenants that were complied with during the year. The facility was operated on an on-call basis, at an interest rate of 6.4% per annum (2003: 5.7% per annum).

14 Property, plant, and equipment

	2004 Cost $'000	2004 Accum Depn $'000	2004 Book Value $'000	2003 Cost $'000	2003 Accum Depn $'000	2003 Book Value $'000
Group						
Land	2,217	–	2,217	2,217	–	2,217
Buildings & improvements	22,888	6,535	16,353	21,901	5,279	16,622
Vessels	18,869	6,706	12,163	18,868	5,947	12,921
Plant & equipment	41,824	31,429	10,395	37,562	27,100	10,462
Electronic data processing equipment	18,228	16,171	2,057	16,417	14,365	2,052
Office equipment	5,933	5,567	366	5,452	5,038	414
Furniture & fittings	1,909	1,687	222	1,891	1,599	292
Motor vehicles	3,089	1,980	1,109	2,884	1,804	1,080
Small boats	1,294	1,002	292	1,263	930	333
Total	**116,251**	**71,077**	**45,174**	**108,455**	**62,062**	**46,393**
Parent						
Land	2,217	–	2,217	2,217	–	2,217
Buildings & improvements	22,668	6,431	16,237	21,681	5,198	16,483
Plant & equipment	35,623	26,513	9,110	31,721	23,185	8,536
Electronic data processing equipment	17,258	15,715	1,543	15,908	14,040	1,868
Office equipment	5,757	5,399	358	5,282	4,879	403
Furniture & fittings	1,525	1,345	180	1,511	1,295	216
Motor vehicles	2,958	1,896	1,062	2,787	1,741	1,046
Small boats	1,011	809	202	998	778	220
Total	**89,017**	**58,108**	**30,909**	**82,105**	**51,116**	**30,989**

14a. Property, plant, and equipment valuation

Independent valuers, Tse Wall Arlidge Limited, undertook a valuation of Land and Buildings in June 2002. This valuation totalled $33.4 million, and while the Directors consider this value to be relevant, they have elected to retain book value for reporting purposes.

14b. Vessels

As agreed with the shareholders, an amount has been earmarked within the Group retained earnings for any shortfall between the current insured value of $40 million and the estimated replacement cost of the research vessel RV *Tangaroa*, in the event of loss of that vessel.

15 Heritage assets

NIWA has one collection and three databases that have been defined as heritage assets. Heritage assets are those assets held for the duration of their physical lives because of their unique scientific importance.

NIWA has the following heritage assets:

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

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

16 Identifiable intangibles

	Group 2004 Actual $'000	Group 2003 Actual $'000	Parent 2004 Actual $'000	Parent 2003 Actual $'000
Copyrights and Trademarks				
At cost	68	–	–	–
Accumulated amortisation	–	–	–	–
Book value	**68**	–	–	–

Identifiable intangibles such as copyrights and trademarks are amortised over their estimated useful lives.

17 Receivables and prepayments

	Group 2004 Actual $'000	Group 2003 Actual $'000	Parent 2004 Actual $'000	Parent 2003 Actual $'000
Trade receivables	14,282	13,913	12,604	13,518
Provision for doubtful debts	(24)	(21)	(24)	(21)
Prepayments	1,311	623	1,090	536
Total	**15,569**	**14,515**	**13,670**	**14,033**
Classified as follows:				
Non-current	**547**	–	**547**	–
Current	**15,022**	**14,515**	**13,123**	**14,033**

The non-current component of receivables relate to the long-term portion of contract retentions included in trade receivables.

18 Inventories

Consumables	457	411	–	–
Finished goods	1,273	674	742	674
Work in progress	356	1	72	1
Total	**2,086**	**1,086**	**814**	**675**

Inventories are not pledged as security for liabilities, nor are any inventories subject to retention of the title clauses.

19 Reconciliation of net surplus after taxation to net cash inflow from operating activities

Net surplus	**5,276**	**4,726**	**3,647**	**3,772**
Add/(less) items classified as investing activities				
Net gain on disposal of property, plant, & equipment	(166)	(136)	(166)	(136)
Add/(less) non-cash items				
Depreciation	9,533	9,548	7,508	7,665
Deficit attributable to minority interests	4	–	–	–
Unrealised changes in the value of subsidiaries	(113)	(100)	–	–
Increase/(decrease) in employee entitlements	(208)	(136)	(205)	(101)
Increase/(decrease) in provisions	(571)	304	(571)	571
(Increase)/decrease in future income taxation benefit	343	(555)	362	(623)
	8,988	9,061	7,094	7,512
Add/(less) movements in working capital items				
Increase/(decrease) in payables and accruals	2,598	2,432	3,285	1,815
Increase/(decrease) in employee entitlements	(1,267)	182	(1,309)	181
(Increase)/decrease in receivables and prepayments	(1,054)	(3,614)	363	(4,058)
(Increase)/decrease in inventory and contract WIP	(1,888)	395	(1,003)	610
(Increase)/decrease in taxation receivable	(89)	(252)	(364)	(100)
	(1,700)	(857)	972	(1,552)
Net cash inflow from operating activities	**12,398**	**12,794**	**11,547**	**9,596**

20 Investments in subsidiaries

Unidata Pty Ltd was acquired on 16 April 2004, and the results of its operations are included in the Group statement of financial performance as from that date. The results of Unidata Pty Ltd's operations contributed a net loss of $6,000 to the consolidated net surplus for the year.

NIWA Natural Solutions Ltd was incorporated on 21 July 2003.

Name	Principal activities	Ownership and voting interest 2004 %	2003 %
NIWA Vessel Management Ltd	Vessel charters for scientific research	100	100
NIWA Natural Solutions Ltd	Commercialisation of NIWA products	100	–
NIWA Australia Pty Ltd	Scientific research and consultancy services	100	100
NIWA Environmental Research Institute	Scientific research and consultancy services	100	100
NIWA (USA), Inc.	Scientific research and consultancy services	100	100
UNIDATA Pty Ltd	Supplier of environmental technology products	80	–

All subsidiaries have a balance date of 30 June.

NIWA Vessel Management Ltd and NIWA Natural Solutions Ltd are the only subsidiaries incorporated in New Zealand. NIWA Australia Pty Ltd and Unidata Pty Ltd are incorporated in Australia. NIWA (USA), Incorporated and NIWA Environmental Research Institute are incorporated in the USA.

NIWA has an A$100 equity investment in NIWA Australia Pty Ltd, a US$1 equity investment in NIWA (USA), Incorporated, and an A$250,000 equity investment in Unidata Pty Ltd. NIWA has no equity investment in NIWA Environmental Research Institute (non-stock corporation). NIWA Environmental Research Institute is a not-for-profit entity which has been classified as a publicly supported organisation, in an advance ruling of the Internal Revenue Service, and as such is exempt from U.S. Federal income tax. This advance-ruling period was valid until 30 June 2004. The classification as a publicly supported organisation is being renewed. NIWA Environmental Research Institute conducts scientific research with a Federal or State focus in the USA.

Subsidiaries purchased

The acquisition of shares in subsidiaries affected the financial position and cash flows as follow:

	Increases from acquisition $'000
Assets	789
Liabilities	(429)
	360
Minority interest	(72)
Purchase price	288
Net outflow of cash to the Group	288

The above values are stated in NZ$ as translated on the acquisition date.

21 Intercompany

	Parent 2004 Actual $'000	Parent 2003 Actual $'000
NIWA non-current liability	**8,015**	**7,631**

An amount of $11.9 million is held by the Parent Company (NIWA) on behalf of NIWA Vessel Management Ltd. This is consistent with the Group policy that all surplus funds are managed by NIWA. This amount is offset by Parent Company receivables and advances to NIWA Australia Pty Ltd of $1.5 million, NIWA Environmental Research Institute of $730,612, NIWA (USA), Incorporated of $538,468, NIWA Natural Solutions Ltd of $701,626, and Unidata Pty Ltd of $387,000, resulting in a net non-current liability of $8.0 million.

During the year NIWA contracted vessel charters from its subsidiary NIWA Vessel Management Ltd totalling $9.1 million (2003: $9.9 million) and purchased workshop services totalling $3,962 (2003: $113,006).

NIWA subcontracted revenue of $102,423 from NIWA Vessel Management Ltd during the financial year (2003: $334,049).

NIWA also charged its subsidiaries for administration expenses and management services totalling $1.1 million for the financial year (2003: $1.1 million).

There were no other significant transactions between any of the companies in the Group. All transactions with subsidiaries are carried out on an arms-length basis.

22 Joint Venture

The Group has a 50% equity interest in EcoConnect Ltd, a joint venture company set up with the United Kingdom Met Office to develop environmental forecasting. The company was formed during June 2004 and had not commenced trading by 30 June 2004.

23 Related party transactions

The Government of New Zealand (the Crown) is the ultimate shareholder of the NIWA Group. All transactions with other Government-owned entities are carried out on an arms-length basis.

Research activities revenue includes amounts received from the Crown or Crown owned entities as follows:

	Group 2004 Actual $'000	Group 2003 Actual $'000	**Parent 2004 Actual $'000**	Parent 2003 Actual $'000
Public Good Science and Technology				
– Contract funding	35,881	36,024	35,881	36,024
– Non-Specific Output Funding (NSOF)	3,710	3,756	3,710	3,756
Ministry of Fisheries	14,602	16,705	14,602	16,705
Ministry for the Environment	396	812	396	812
Department of Conservation	1,334	799	1,334	799
Land Information New Zealand	5,553	1,328	5,553	1,328
Genesis Energy	1,029	407	1,029	407
Meridian Energy	573	474	573	474
Mighty River Power	499	403	499	403

24 Guarantees

The National Bank of New Zealand Limited holds a guarantee, on behalf of NIWA, in the amount of $360,000 (2003: $360,000). The guarantee is held in relation to a Land Information New Zealand contract for funds that will be received by NIWA on completion of milestones to contract specifications.

25 Segment information

The Group operates predominantly in two industries – research and vessel charter.

Industry Segments	**Total**		**Research**		**Vessel charter**		**Eliminations**	
	2004 $'000	2003 $'000	**2004 $'000**	2003 $'000	**2004 $'000**	2003 $'000	**2004 $'000**	2003 $'000
Revenue:								
From customers outside the Group	84,631	84,200	82,378	82,355	2,253	1,845	–	–
Inter-segment	–	–	102	–	9,136	10,000	(9,238)	(10,000)
Total revenue	**84,631**	**84,200**	**82,480**	**82,355**	**11,389**	**11,845**	**(9,238)**	**(10,000)**
Surplus before taxation	7,006	7,207	4,548	5,474	2,458	1,738	–	(5)
Unallocated expenses	30	9						
Total surplus before taxation	**7,036**	**7,216**						
Segment assets	72,284	66,678	56,061	50,467	16,223	16,211	–	–
Unallocated assets	–	–						
Total Assets	**72,284**	**66,678**						

The major products or services from which the above segments derive revenue are:

Segment	**Products and services**
Research	Atmospheric and aquatic research, consultancy, and associated products and services
Vessel charter	Charter of vessels for scientific research

All inter-segment pricing is on an arm's-length basis.

26 Financial instruments

26a. Currency and interest rate risk

Nature of activities and management policies with respect to financial instruments:

(i) Currency

Currency risk is the risk that the value of a financial instrument will fluctuate due to changes in foreign exchange rates.

The Group undertakes transactions denominated 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 transaction risks as they arise, unless explicitly authorised by the Board. To manage these exposures, the Group uses forward foreign exchange contracts. At balance date the Group had no forward foreign exchange arrangements in place.

(ii) Interest rate

Interest rate risk is the risk that the value of the financial instrument will fluctuate because of changes in market interest rates. This could particularly affect the cost of borrowing and the return on investments.

The interest rates on NIWA's borrowings during the year were:

	2004	2003
On call	5.7–6.4%	5.7–6.2%
Short term	6.3–6.4%	6.3–6.4%

The interest rates on NIWA's investments during the year were:

	2004	2003
Cash (on call)	5.0–5.8%	5.3–5.8%
Short term	5.0–5.8%	–

Short-term deposits have maturity dates less than 6 months. The Directors do not consider there is any significant exposure to interest rate risk on investments. All investments are managed by NIWA on behalf of the Group.

NIWA has a regularly reviewed Treasury Policy in place which ensures the appropriate management of currency and interest rate risk.

(iii) 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 and transactions with financial institutions (cash and short-term deposits). 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 we deal 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 trade receivables dealt with.

26b. Fair values

The estimated fair values of the Group's financial instruments approximate their carrying values as disclosed in the Statement of Financial Position.

27 Commitments

	Group 2004 Actual $'000	Group 2003 Actual $'000	**Parent 2004 Actual $'000**	Parent 2003 Actual $'000
27a. Operating lease obligations				
Obligations payable after balance date on non-cancellable operating leases:				
Within 1 year	704	779	694	746
Between 1 and 2 years	279	606	279	606
Between 2 and 5 years	632	591	632	591
Over 5 years	2,503	2,807	2,503	2,807
	4,118	**4,783**	**4,108**	**4,750**
27b. Capital commitments				
Commitments for future capital expenditure:				
Contracted, but not provided for	428	286	428	286
	428	**286**	**428**	**286**

28 Contingent liabilities

New Zealand companies have a contingent liability in respect of the Accident Compensation Commission's residual claims levy. The levy will be payable annually from May 1999 for up to 15 years. Each company's future liability depends on ACC's unfunded liability for past claims and future payments to employees by these companies. There are no other significant contingent liabilities that require disclosure in the Financial Statements.

29 Subsequent events

The Board of Directors declared a dividend of $15.0 million on 25 August 2004. In accordance with FRS-5 Events after Balance Date, this dividend has not been provided for in the Statement of Financial Position as at 30 June 2004.

Auditor's report

Deloitte.

TO THE READERS OF

NATIONAL INSTITUTE OF WATER AND ATMOSPHERIC RESEARCH LIMITED AND GROUP'S FINANCIAL STATEMENTS FOR THE YEAR ENDED 30 JUNE 2004

The Auditor-General is the auditor of National Institute of Water and Atmospheric Research Limited (the company) and group. The Auditor-General has appointed me, Andrew Burgess, using the staff and resources of Deloitte, to carry out the audit of the financial statements of the company and group, on his behalf, for the year ended 30 June 2004.

Unqualified Opinion

In our opinion:

- The financial statements of the company and group on pages 47 to 58:
  - comply with generally accepted accounting practice in New Zealand; and
  - give a true and fair view of:
    - the company and group's financial position as at 30 June 2004; and
    - the results of operations and cash flows for the year ended on that date.
- Based on our examination the company and group kept proper accounting records.

The audit was completed on 25 August 2004, and is the date at which our opinion is expressed.

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

Basis of Opinion

We carried out the audit in accordance with the Auditor-General's Auditing Standards, which incorporate the New Zealand Auditing Standards.

We planned and performed our audit to obtain all the information and explanations we considered necessary in order to obtain reasonable assurance that the financial statements did not have material misstatements, whether caused by fraud or error.

Material misstatements are differences or omissions of amounts and disclosures that would affect a reader's overall understanding of the financial statements. If we had found material misstatements that were not corrected, we would have referred to them in the opinion.

Our audit involved performing procedures to test the information presented in the financial statements. We assessed the results of those procedures in forming our opinion.

Audit procedures generally include:

- determining whether significant financial and management controls are working and can be relied on to produce complete and accurate data;
- verifying samples of transactions and account balances;
- performing analyses to identify anomalies in the reported data;
- reviewing significant estimates and judgements made by the Board of Directors;
- confirming year-end balances;
- determining whether accounting policies are appropriate and consistently applied; and
- determining whether all financial statement disclosures are adequate.

We did not examine every transaction, nor do we guarantee complete accuracy of the financial statements.

We evaluated the overall adequacy of the presentation of information in the financial statements. We obtained all the information and explanations we required to support the opinion above.

Responsibilities of the Board of Directors and the Auditor

The Board of Directors is responsible for preparing financial statements in accordance with generally accepted accounting practice in New Zealand. Those financial statements must give a true and fair view of the financial position of the company and group as at 30 June 2004. They must also give a true and fair view of the results of operations and cash flows for the year ended on that date. The Board of Directors responsibilities arise from the Crown Research Institutes Act 1992, the Public Finance Act 1989 and the Financial Reporting Act 1993.

We are responsible for expressing an independent opinion on the financial statements and reporting that opinion to you. This responsibility arises from section 15 of the Public Audit Act 2001, section 43(1) of the Public Finance Act 1989 and section 21(1) of the Crown Research Institutes Act 1992.

Independence

When carrying out the audit we followed the independence requirements of the Auditor-General, which incorporate the independence requirements of the Institute of Chartered Accountants of New Zealand.

In addition to the audit we have carried out assignments in the areas of taxation and other assurance services, which are compatible with those independence requirements. Other than the audit and these assignments, we have no relationship with or interests in the company and group.

A G Burgess
DELOITTE
On behalf of the Auditor-General Auckland, New Zealand

Directory National Institute of Water & Atmospheric Research Ltd

Directors

Sue Suckling *(Chair)*
Dr Carolyn Burns
Miranda Cassidy
John Hercus
Dr Graham Hill
Troy Newton
David Sharp
John Spencer

Executive

Dr Rick Pridmore
Chief Executive Officer

Dr Bryce Cooper
Director, Strategic Development

Dr Mark James
Director, Operations

Dr Rob Murdoch
Director, Research

Dene Biddlecombe
Chief Financial Officer & Company Secretary

Dr Neil Andrew
General Manager, Marine & Aquaculture

Dr Clive Howard-Williams
General Manager, Freshwater & Education

Dr John McKoy
General Manager, Fisheries & Bioactives

Dr Murray Poulter
General Manager, Atmosphere

Dr Don Robertson
General Manager, Biodiversity, Biosecurity, & Information Services

Dr Charlotte Severne
General Manager, Māori Development

Registered Office and Address for Service

269 Khyber Pass Road
Newmarket
Auckland
New Zealand

Corporate Office

369 Khyber Pass Road
Newmarket, Auckland
Private Bag 99940
Newmarket, Auckland
New Zealand
Tel +64-9-375 2090
Fax +64-9-375 2091

National Centres

Aquatic Biodiversity & Biosecurity
www.niwa.co.nz/ncabb

Climate
www.niwa.co.nz/ncc

Climate–Energy Solutions
www.niwa.co.nz/ncces

Fisheries & Aquaculture
www.niwa.co.nz/ncfa

Natural Hazards
www.naturalhazards.net.nz

Water Resources
www.niwa.co.nz/ncwr

Te Kūwaha
www.niwa.co.nz/rc/maori

Auditors

Deloitte on behalf of the Auditor-General

Bankers

The National Bank of New Zealand Limited

Solicitors

Bell Gully Buddle Weir
Kaimai Law

Insurance broker

Marsh Limited

NIWA Vessel Management Ltd

301 Evans Bay Parade, Wellington
Tel +64-4-386 0550
Fax +64-4-386 0555

NIWA Natural Solutions Ltd

369 Khyber Pass Road
Newmarket, Auckland
Private Bag 99940
Newmarket, Auckland
Tel +64-9-375 2090
Fax +64-9-375 2091

NIWA in the USA

c/- Limno-Tech Inc.
501 Avis Drive, Suite 120
Ann Arbor
Michigan, 48108
USA
www.niwa-eri.org

NIWA Australia Pty Ltd

Terrace Office Park,
527 Gregory Tce,
Bowen Hills, Brisbane
P O Box 359, Wilston, QLD,
Australia 4051
Tel +61-7-3257 0522
Fax +61-7-3257 0566
www.niwa.com.au

Unidata Pty Ltd

40 Ladner Street,
O'Connor, WA 6163
Tel +61-8-9331 8600
Fax +61-8-9331 8611
www.unidata.com.au

Communications Manager
Geoff Baird
g.baird@niwa.co.nz
Tel +64-4-386 0543
Fax +64-4-386 0574

Regional Offices

Auckland
Manager: Dr Mike Timperley
m.timperley@niwa.co.nz
Cnr Mountain Road & Khyber Pass Road, Newmarket
Private Bag 109695, Auckland
Tel +64-9-375 2050
Fax +64-9 375 2051

Hamilton
Manager: Dr Dave Roper
d.roper@niwa.co.nz
Assistant RM: Dr Terry Hume
t.hume@niwa.co.nz
Gate 10, Silverdale Road, Hillcrest
P O Box 11115, Hamilton
Tel +64-7-856 7026
Fax +64-7-856 0151

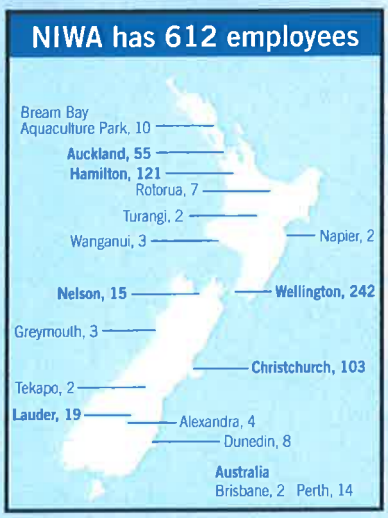
Wellington
Managers: Dr Rosie Hurst
r.hurst@niwa.co.nz
Dr Andrew Laing
a.laing@niwa.co.nz
301 Evans Bay Parade, Greta Point
Private Bag 14901, Wellington
Tel +64-4-386 0300
Fax +64-4-386 0574

Christchurch
Manager: Dr Barry Biggs
b.biggs@niwa.co.nz
Assistant RM: Charles Pearson
c.pearson@niwa.co.nz
10 Kyle Street, Riccarton
P O Box 8602, Christchurch
Phone +64-3-348 8987
Fax +64-3-348 5548

Nelson
Manager: Dr Ken Grange
k.grange@niwa.co.nz
217 Akersten St, Port Nelson
P O Box 893, Nelson
Tel +64-3-548 1715
Fax +64-3-548 1716

Lauder, (Central Otago)
Manager: Charles Pearson
c.pearson@niwa.co.nz
State Highway 85, Lauder
Private Bag 50061, Omakau, Central Otago
Tel +64-3-447 3411
Fax +64-3-447 3348

NIWA Regional Managers: (left to right) Dave Roper, Ken Grange, Barry Biggs, Rosie Hurst, Terry Hume, Mike Timperley, Andrew Laing. Inset: Charles Pearson.



NIWA on the web

www.niwa.co.nz

Photography (all NIWA staff except where indicated)

Cover: Malcolm Francis; IFC: Neil Bagley; 2, 3, & 6: Alan Blacklock; 7: Nelson Boustead; 11: Mike Kotkamp, Richard McKenzie (insert); 12: Bob Murray, Alan Blacklock, NIWA (insert); 13: Mike Timperley, Mal Green; 15: Alan Blacklock, NIWA; 16: Neil Bagley, Malcolm Francis; 17: Alan Blacklock, Els Maas (insert), Erina Watene, Alan Blacklock (insert); 18: Rod Budd, NIWA, Clive Howard-Williams; 19: Greg Foothead, Stefano Schiaparelli (University of Genoa), Neil Bagley; 20: Alan Blacklock; 22: Michelle Kelly Shanks, Ross Martin, Graham Fenwick, Alan Blacklock; 23 & 24: Alan Blacklock; 25: Bill Main, Marine Current Turbines Ltd (graphic); 26: NIWA, Nelson Boustead, Doug Griffin, Alan Blacklock; 28: NIWA, The Northern Advocate, *Sheryl Miller, Kelly May; 29: Tracey Edwards, Kelly Tarlton's Underwater World, Nelson Boustead, NIWA, Nelson Boustead; 30: NIWA, John McKoy; 31: Doug Ramsay, Mike Butler, NIWA; 32: John Mitchell, Stuart Hanchet; 33: Mike Kotkamp; 34: Nelson Boustead; 35: Rod Budd, NIWA, Rob Murdoch, John Quinn; 36: Nelson Boustead, Denis Maindonald, Jeremy McKenzie; 44 & IBC: Alan Blacklock.*

National Institute of Water & Atmospheric Research Ltd