NZHS E-CURRENT NEWSLETTER • NUMBER 69 • APRIL 2026

NEW ZEALAND HYDROLOGICAL SOCIETY

E-CURRENT NEWSLETTER

INSIDE THIS EDITION

Matt Hope, KISTERS

MESSAGE FROM EXECUTIVE

Kia ora – Welcome, New Zealand Hydrological Society Members, to the Autumn edition of Current.

Kia ora,

Welcome to the latest edition of e-Current. It's a pleasure to connect with you all and to reflect on what has already been a busy and rewarding period for the Society.

A highlight over the past month was our Technical Workshop, held from 24 to 26 March at Shantytown in Greymouth. The workshop was a great success, with a record attendance of just over 170 delegates. It's clear that this event continues to grow in popularity and is fast becoming a staple in the technical hydrology calendar.

This year's theme "Back to Basics" resonated strongly throughout the programme. We saw a wide range of high-quality presentations, all grounded in the fundamentals of our discipline, alongside plenty of valuable technical discussion during breaks and social events. These conversations are always a key part of the workshop and highlight the strength of our hydrological community.

Wednesday provided attendees with a choice of two excellent streams — the gauging regatta at Hokitika Gorge and the data-focused sessions at Shantytown. Both were well attended and provided great opportunities for hands-on learning and technical exchange. The trade workshops held alongside these sessions were also a real success, giving suppliers and specialists the opportunity to share knowledge and engage directly with practitioners.

We were also pleased to welcome three representatives from the Korea Institute of Hydrological Survey (KIHS), who contributed to the workshop through presentations on their hydrological research. Their involvement continues to strengthen our international connections and knowledge sharing.

The workshop concluded with the dinner and prizegiving on Thursday evening. A standout moment was the presentation of the Achievement in Operational Hydrology Award to Pete Mason. The citation, delivered by Samwell Warren, provided a fitting tribute to Pete's long-standing contribution to hydrology and his passion for the profession.

I would also like to acknowledge and thank the organising committee for their efforts in delivering such a successful Technical Workshop, along with our sponsors for their continued support, and the 16 trade organisations who attended. The contribution from the organising committee, sponsors, and trade partners plays a vital role in the success of the workshop — quite simply, the event would not happen without their ongoing support.

Following the workshop, members of the Society, alongside Earth Sciences and KIHS representatives, met in Christchurch to formalise a Memorandum of Understanding. This agreement will support ongoing collaboration and the sharing of research and knowledge between our organisations — an exciting step forward for future work in hydrology. It was also a privilege to have the President of KIHS travel from Korea to be part of the signing.

Looking ahead, planning is already underway for next year's Technical Workshop, which will be held in Wellington. Further details will be shared with members later in the year, but for now, I encourage you to keep late March / early April free in your calendars.

Planning is also well underway for the combined NZHS and Rivers Group Conference, which will be held in Nelson from 17 to 20 November. Following the strong momentum from this year's Technical Workshop, we are looking forward to another well-supported event. Abstract submissions and registrations open mid-April. The sponsorship prospectus is also available, and we invite you to have a look and see how your organisation can get involved in supporting the event.

I encourage you to keep an eye on the conference website for updates and to start planning your involvement:

https://www.nzhsrivers.co.nz/

As always, this edition of e-Current brings together a range of updates, articles, and insights from across our community. Thank you to all those who have contributed — your input is what continues to make this publication both relevant and valuable.

I hope you enjoy this edition.

Ngā mihi,

Matt Hope

NZHS Executive Committee Member

CONTENTS

e-Current is the newsletter of the New Zealand Hydrological Society Inc. Contributions are welcome from members at any time and can be sent to admin@hydrologynz.org.nz

Advertising space is available; contact Lea Boodee at the above address for more info.

AWARDS

It is always great to see members acknowledged for their contributions to the hydrology domain.

Richard Hawke was awarded a life membership at the 2025 NZHS AGM in Hamilton. This honour recognises his significant contribution and service as Editor for the Society's journal for 22 years.

John Hadfield was awarded the Outstanding Achievement Award at the 2025 Conference Dinner. This award celebrates his contributions to hydrological science and water-resource management in New Zealand.

Pete Mason was awarded the Achievement in Operational Hydrology Award during last month's technical workshop, recognising his contribution to operational hydrology over the last 50 years.

On behalf of our members, congratulations and more importantly thank you for your contributions to hydrology in New Zealand.

Please don't forget to provide nominations for these awards and others at any time. Please check the NZHS website for full details on criteria and past recipients.

Mike Ede
NZHS President

LIFE MEMBER AWARD

Dr Richard Hawke

Richard studied at Victoria University of Wellington in the late 1980s. While he had started out intending to become an architect, at university he discovered his passion for physical geography and hydrology, and after graduating with a BA in 1989 he decided to carry on down the science path.

That summer, Richard joined Victoria University of Wellington's 34th Antarctic Expedition as a graduate student. He was part of a small team that spent three months studying the hydrology, glaciology, and sediment transport processes in the Miers Valley, one of the smaller 'dry valleys' in Victoria Land. The fieldwork for his Honours dissertation involved testing and calibrating several theoretical sediment transport equations using the natural laboratory created by diurnal flow variation in Miers Stream. Richard was an enthusiastic and valuable team member and even joined the exclusive 'Lake Miers Swim Club'. The expedition was a great success, with the team later publishing several papers summarising the results of their investigations and Richard completing his Honours dissertation Fluvial sediment transport in the Miers Valley, Antarctica.

On the strength of his Honours year, Richard was awarded a Commonwealth Scholarship to support PhD studies at the University of Toronto. There he developed his interest in digital instrumentation, datalogging, and continuous in situ field monitoring, with a particular focus on hillslope hydrology. His PhD thesis, completed in 1997, The energetics and dynamics of surface sealing led to publication of several papers focusing on rill development and soil erosion. While at Toronto, Richard met his wife Carole,

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After completing his PhD, in 1998 Richard returned to Victoria University of Wellington, first as a Lecturer and then a Senior Lecturer, where he helped develop and strengthen the hydrology programme. He continued his research in soil hydraulics, including detailed real-time in situ measurements of soil moisture and pore water pressures in slopes subject to shallow landslides and the efficiency of different irrigation systems and regimes in Wairarapa. The enthusiastic young lecturer with waist-length red hair was popular with students, leading to him supervising many graduate students studying a broad range of topics. Richard kick-started the career of many of his students by helping them find work as 'summer students', and collectively his former students now hold a wide range of positions in science and environmental policy in central government, councils and consultancies in New Zealand and overseas.

While at VUW, and in his spare time, Richard completed an MBA. In 2004, he had a career shift, leaving science and academia to focus on his other passion – economics. Since then, he has held various roles in policy advice and management at the Ministry of Economic Development, MBIE and, currently, Land Information New Zealand and continues to serve New Zealand by providing sage advice to Government.

Richard became an active member of the Hydrological Society during his time at Victoria University, regularly attending the annual conferences and reviewing papers for the journal. At the end of 2003 he agreed to take on the role of Editor, and likely never imagined he would carry out this role for 22 years.

During his (more than) two decades as Editor, Richard has overseen the publication of 42 issues of the Journal, comprising more than 200 papers. Of note, he instigated several 'special issues' showcasing a diverse range of hydrological topics: sediment transport, wastewater epidemiology, and – most recently – the Christchurch Artesian System. In 2011, he oversaw the production of the 'Red Book' – the 50th anniversary edition of the Journal, reporting on 'hydrology through the ages'. A decade later, with equal enthusiasm, he was the driving force behind the 'Orange Book' – the 60th anniversary edition. Richard brought to the role a passion for ensuring research is never 'lost', often working through several iterations of papers with authors, while continuing the high standard for which the Journal is known.

AWARDS

Outstanding Achievement Award: John Hadfield

Nicki Wilson presenting John his award at the 2025 conference dinner in Hamilton.

John has dedicated over four decades of service to hydrogeology and made a lasting mark on groundwater science and water resource management in Aotearoa. A graduate of the University of Waikato, he holds a B.Sc. in Earth Sciences, a Postgraduate Diploma in Applied Science (Water Resources), and a Master of Philosophy focused on groundwater contaminant transport.

His career begun with Büro für Hydrogeologie in Switzerland and Groundwater Consultants (NZ) Ltd. He later joined Waikato Regional Council (WRC) at its establishment in 1989, having previously worked for its predecessor organisations—the Waikato Catchment Board and the Waikato Valley Authority.

Throughout his public service career, John has been a pioneering force in groundwater quality issues and a cornerstone of hydrogeological expertise in the Waikato Region. His scientific expertise has shaped regional and national policy, notably including contributions to the Taupo Variation of the Waikato Regional Plan, advisory work for the Ministry of Health during the development of the 2005 Drinking Water Standards, and the establishment of Waikato's community (school) monitoring network.

John has consistently demonstrated a strong commitment to advancing the field by actively participating in, and lending his expertise to, national research projects and initiatives. His willingness to collaborate and support efforts has made a significant impact on the broader scientific community. He responds swiftly and effectively to environmental concerns. Examples include the Lake Taupō Protection Science programme (from 2000 to present), championing the first capture zone delineation guideline in NZ (2010 – 2014), the Waikato pesticides survey (1999) and glyphosate survey (2017), the first baseline survey for emerging contaminants in NZ (2018-2019), and the development of a national monitoring framework for groundwater quality (2023-2025) - initiating a step change in how we monitor groundwater quality in NZ.

John was a trailblazer in advancing the understanding of denitrification processes in the Waikato region. His innovative work included conducting tracer and push-pull tests using a caisson to isolate aquifers in the Taupo area. He also introduced the Childs Test as a standard redox indicator for wells drilled across Waikato, which played a pivotal role in guiding well installation and shaping the design of monitoring networks. Additionally, he has contributed to national research efforts focused on the prediction of groundwater redox conditions.

A respected scientist, John has authored numerous technical reports, conference papers and authored chapters of textbooks. His ability to communicate complex scientific issues in simple, relatable terms has made him a trusted advisor to colleagues, decision-makers and the public. He has served in advisory groups for large research programmes (e.g. Smart Aquifer Characterisation Programme), for the Parliamentary Commissioner for the Environment, provided external reviews for government ministries, and has played a key role in the review of NZS4411 – the environmental standard for drilling of soil and rock following the Havelock North water crisis. His credibility as scientist is well established, with appearances in the Criminal, Environment, and District Courts.

A past Convener of the New Zealand Regional Groundwater Forum and honorary lecturer at the University of Waikato, John has generously shared his knowledge and experience. Working with John is inspiring: he is genuinely interested in science and navigates easily between the multiple aspects of hydrogeology. He has provided many early career scientists and colleagues with mentorship and opportunities to grow.

John is recognised not only for his scientific contributions but also for his approachable, down-to-earth nature and curiosity. Whether it's coding beer receipts as "drilling fluids" or sleeping in his van during 24-hour pumping tests, he fosters camaraderie and builds connections. He has a humble, genuine approach and leads by example. Whether he's out catching waves or embarking on adventures around the world, he brings the same enthusiasm and inquisitiveness to his personal life as he does to his professional work, making the most of every opportunity both in and out of the office.

AWARDS

Operational Hydrology Award: Peter Mason

Pete on the impromptu field trip at Lake Trevallyn, during the AHA conference: May 2025

Pete began work as a hydrology cadet straight from high school at the age of 17. His first posting with the Ministry of Works was on the West Coast, where on day one, Pete was off the train and strait up to Ahaura and thrown in a cableway. His love for hydrology was instant and spent the rest of his career dedicated to field hydrology.

Following his training on the West Coast Pete later specialised in snow survey and glaciology in the Southern Alps and went on to make three trips to the Antarctic Dry Valleys, carrying out hydrology and glaciology work. Pete was a member of the infamous Asgard Rangers, who (alongside the Vanda Vandals) were a group of hydrologists, geologists, glaciologists and other...ists that roamed the Wright Dry Valley, Lake Vanda and surrounding ranges, mostly in the name of science. He then transferred to Lake Tekapo for two years, where he worked on the Tasman Glacier and conducted snow surveys in the Mackenzie Basin.

After returning to the West Coast for another couple of years, he took three years' leave to complete his overseas experience. He travelled to the United Kingdom via the Panama Canal, toured Europe, and returned overland as far as Western Australia, where he found work in the Outback carrying out mineral exploration in the Kimberley region for Australian Anglo American Ltd.

He eventually returned to New Zealand to continue his career, this time specialising in irrigation hydrology in the Canterbury region. He rejoined the Christchurch hydrological field team with DSIR (later NIWA) and became Field Team Leader. In this role, he was responsible for a team of three carrying out hydrological work throughout Canterbury, including the Chatham Islands.

His first trip to the Chatham Islands was in 1987, when he became involved with the Liquid Fuels Trust Board. During the oil crisis, the Board investigated alternative fuel sources, including the extraction of liquid methanol from peat reserves on the islands. His role involved hydrological research on peat basins to assess the feasibility of this proposal. Although the project did not proceed at the time, the work led to hydropower investigations, and as a result he continued working on the Chatham Islands for more than 20 years.

He also initiated a five-year contract through NZAID to establish a hydrological monitoring network for Rarotonga. This project involved measuring water flows from the island's nine major streams, which supply its freshwater. The work included building weirs to measure flows, installing automatic rain gauges, and training local field staff to maintain equipment and archive data for engineers redesigning water supply intakes. During the contract, he travelled to Rarotonga annually to update data and continues to provide training support. In addition, he has made three trips to Samoa undertaking similar work and was involved in training surface-water and groundwater technicians from across the Pacific at the SOPAC offices in Suva over a three-year period.

In 1991, Pete co-authored the Manning's n book with Murray Hicks. Drawing on his extensive field experience, the publication provided practical guidance on estimating hydraulic roughness in natural channels and became a valued reference for hydrologists and water-resource practitioners. The book reflected Pete's strong emphasis on applied field knowledge and his ability to translate complex hydrological observations into usable guidance for others.

In 2021 Pete was pulled out of retirement to assist the West Coast Regional Council hydrology field team to providing some much-needed experience to budding field technicians. Pete quickly got to work, reinstating the value of gauging rivers and casting a practical eye of day-to-day operations. Since 2023, Pete has assisted in the construction of numerous river level and rainfall sites throughout the region, overseen cableway operation and training, spearheaded a study on comparing slope area methodologies against new technologies, and re-surveyed all WCRC sites to national datums.

Pete's love of hydrology still carries him and, despite his pending 'decommissioning', Pete continues to advance NZ Hydrology, successfully gaining funding to return to the Antarctic Dry Valleys to conduct further surveys of the glaciers he worked on during the start of his career.

With such a notable career, it was a privilege to award Pete Mason the *New Zealand Hydrological Society Achievement in Operational Hydrology Award* at the recent NZHS Technical Workshop at Shantytown on the West Coast.

New special interest group: Te rōpū Māori

Recognising the particular importance of water to Māori, as well as the unique place te ao Māori has in understanding and managing water, the NZHS is forming a special interest group - te rōpū Māori. The rōpū will firstly be a space for whanaungatanga among those who identify as Māori or who work closely with Māori. It will also be a space to discuss how to elevate te ao Māori within the Society, and how the Society can better meet the needs of Māori both inside and outside the Society.

If you would like to get involved, please get in touch with Daniel Collins (Ngāpuhi) directly or via

admin@hydrologynz.org.nz.

Journal of Hydrology (New Zealand)

The Journal of Hydrology (New Zealand) is published twice a year. - https://www.hydrologynz.org.nz/journal-of-hydrology.

The Journal contains Papers and Notes on all aspects of hydrological science and management. I would especially like to encourage those who presented at the Conference to consider sharing your work with others through publication.

Papers and Notes can be sent to the Editor (admin@hydrologynz.org.nz) at any time. I aim to have papers and notes reviewed in under two months and publish accepted material within a year. 'Notes' are generally short, maybe 4 to 8 pages. Notes are intended to be pilot studies, work that is not completed or technical information (ie interesting and relevant material that is not a final article).

I am also keen to build my pool of potential reviewers, If you are interested please email admin@hydrologynz.org.nz

If you want to discuss your potential publication please don't hesitate to contact me.
Louise Weaver, Editor, Journal of Hydrology (New Zealand)

NZHS Award Nominations

In line with their mission to support and foster hydrology in New Zealand and elsewhere, and to enable NZHS members to receive advanced training in hydrological sciences, NZHS annually presents several student and non-student awards to its members.

A listing of all the awards, nomination criteria and nomination forms can be found on the NZHS website. https://www.hydrologynz.org.nz/awards

Members are encouraged to think about colleagues who deserve some recognition for their contribution to hydrology and submit nominations.

NZHS–MSNZ 2025 Joint Conference Summary

By Nicki Wilson, Waikato Regional Council

We would like to thank all attendees, presenters, sponsors, and exhibitors for contributing to the success of the 2025 New Zealand Hydrological Society / Meteorological Society of New Zealand Joint Conference, held 2–5 December in Kirikiriroa Hamilton.

The conference brought together 229 delegates from a wide range of sectors including research, academia, consulting, industry, local government, and iwi organisations, with approximately 68% representing NZHS and 32% representing MSNZ. We were also thrilled to welcome delegates from the Korean Water Resources Association to the conference. The joint format once again provided a valuable opportunity for hydrologists and meteorologists to connect, share knowledge, and collaborate across disciplines.

Participants enjoyed a diverse and engaging technical programme featuring three keynote speakers, 141 oral presentations, 23 poster presentations, and 8 'lightning talks'. The lightning talks were a new addition this year, each offering a concise 5 minute presentation - we welcome feedback on whether this format was valuable. Topics spanned hydrology, meteorology, climate science, modelling, water management, and decision support, reflecting both the breadth of expertise within the community and the urgency of addressing climate and water challenges.

A social programme supported opportunities for networking and connection throughout the week. Events included a Welcome Function at Claudelands, a student function, a sponsored social evening at the Hamilton Cosmopolitan Club, and the conference dinner at Hamilton Gardens. It was great to see many participants getting into the Middle Earth theme with some creative costumes. We had some great feedback on the local band The Vinyl Frontier, who also took the opportunity to dress to the theme!

The conference concluded with two popular Friday field trips. Delegates had the opportunity to visit Blue Springs, Hinuera Stone Quarry and Hobbiton, or explore the Waikato River, Arapuni Dam and Karapiro Dam, providing insight into the region's hydrological systems, infrastructure, and environmental management.

Overall feedback on the conference was highly positive, with attendees praising the programme, venue, and field trips. Although attendance was lower than in some previous years, the event remained strong and engaging.

We extend our sincere thanks to the Conference Organising Committee: Alanna Burrows, Nicolas Cullen, Mike Ede, Clare Houlbrooke, Andrew Hughes, Roland Stenger, Thomas Wilding, Nicki Wilson and Tracy Young, and all those who contributed their time and expertise to make this event possible. It is always a privilege to come together in person, and we hope the discussions, connections, and ideas sparked during the conference continue to support collaboration and innovation across our communities.

NZHS | Rivers Group Conference

Welcome

On behalf of the organising committee, we invite you to this year's NZ Hydrological Society | NZ Rivers Group Joint Conference in Whakatū | Nelson.

The theme, "Ripple Effects – understanding the impacts of today's decisions in a changing environment," highlights how societal choices affect our water. Through collaboration and knowledge sharing, we can better understand and manage these impacts.

This conference aims to bring our fields together to address current challenges, celebrate achievements, and explore future opportunities. Alongside technical sessions, there will be networking events and a field trip on Friday to the Waimea Dam and its downstream users, including orchards, industry and market gardens.

2026 marks the 65th Anniversary of NZHS. This is the NZHS's third time hosting the conference in Nelson (previously in 1993 and 2012), and the Rivers Group last held their conference here in 2023. There are strong synergies between NZHS and the Rivers Group, and we are pleased to offer another joint conference to strengthen our collaboration.

We look forward to welcoming you in Whakatū | Nelson.

Damian Vellupillai - Tonkin+Taylor | NZ Rivers Group
Joseph Thomas - Tasman District Council | NZ Hydrological Society
2026 Conference co-chairs

Check out our website for more details at https://www.nzhsrivers.co.nz/
Abstracts are open and registration opens 1st of May.

WORKSHOP

NZHS Technical Workshop 2026

Back to Basics: Core Principles for a New Era

Photos from this year's workshop in Shantytown

SAVE THE DATE FOR 2027
16-18 MARCH | LOWER HUTT EVENT CENTRE

CREATIVE HYDROLOGY

We welcome (actually encourage) all members to send us a creative contribution for the next Current.

Q. How do you make a waterbed bouncy?
A. Fill it with spring water

Q. How do engineers pick a location for a hydro-power dam?
A. They assess the hydrology of several locations along the river, examine the geology of the underlying rock, determine the feasibility of bringing in materials and equipment, then they pick a spot that's a damsite better than the others.

Jokes contributed by Lee Burbery, DairyNZ

ARTICLE

Integrated Geophysical Aquifer Modelling at Owl Farm

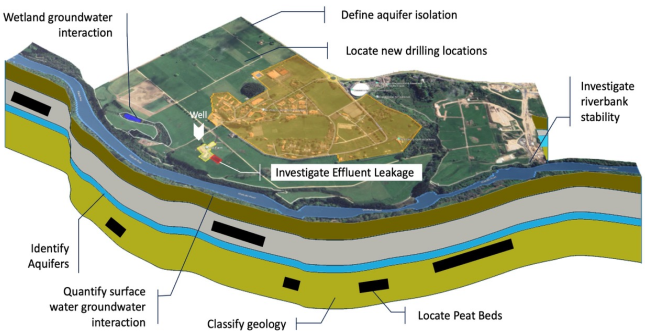
A case study in groundwater characterisation, yield estimation and environmental risk assessment (including natural dewatering into the Waikato River)

By John McKendry
Managing Director, Aquifer Mapping Ltd

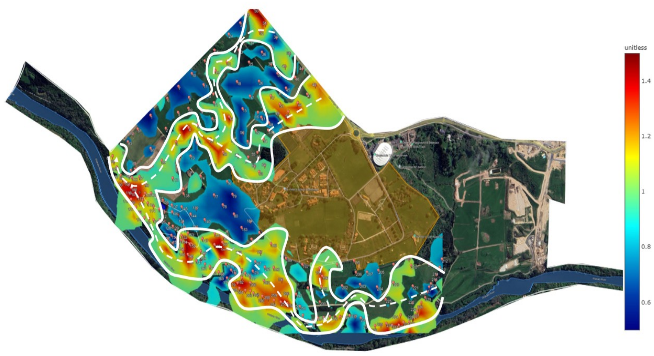
Executive summary

The 2025 Owl Farm Survey demonstrates how integrated geophysical modelling can be applied to delineate aquifer systems, estimate sustainable groundwater yields, evaluate nutrient leaching risk, and assess riverbank stability in intensively farmed catchments. Using electro-seismic interpretation combined with GIS datasets and 3D modelling, the study provides a comprehensive decision-support framework for groundwater development and environmental management.

Background and geological setting

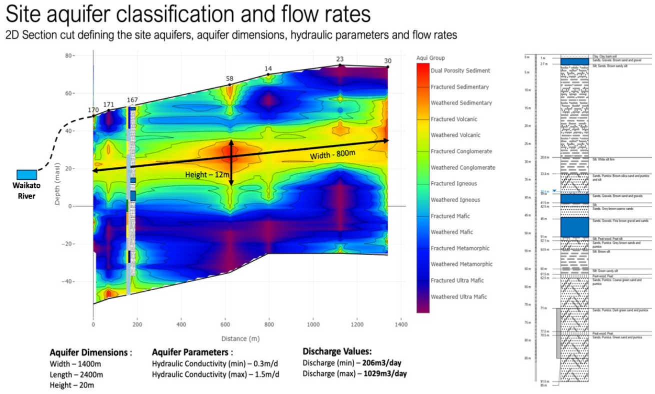


Owl Farm is situated within a sedimentary river basin system classified as having moderate groundwater yield potential. Regional aquifer and lithology datasets indicate gravel aquifers interbedded with low-permeability silts, pumice, and clay-bearing formations. The boundary between sedimentary cover and basement material was identified as a critical control on aquifer behaviour.



Aquifer architecture and paleo-channel systems

Geophysical modelling identified localised gravel beds consistent with fluvial deposition mechanics, including paleo-channel formations at approximately 24 masl. Primary and secondary channel systems were interpreted, representing high-value groundwater targets due to enhanced hydraulic conductivity and transmissivity.



Aquifer discharge estimation

A representative aquifer body was modelled with the following parameters:

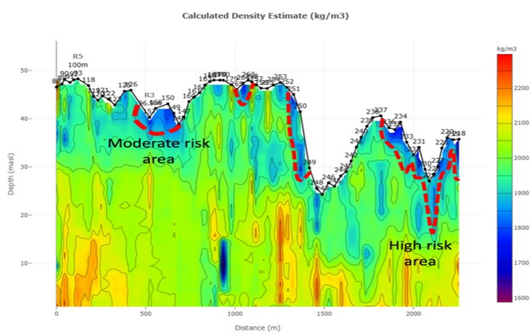
- Width: 800 m
- Length: 2400 m
- Height: 12 m
- Hydraulic Conductivity: 0.3–1.5 m/day

Estimated discharge ranged between 129 m^3/day and 648 m^3/day, reflecting uncertainty bounds in formation properties.

Environmental risk and nutrient management

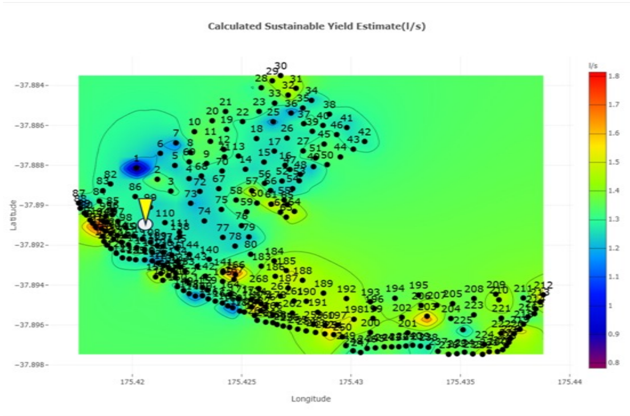
Hydraulic conductivity mapping of the northeast fertilisation field identified zones of higher seepage potential. Aquiclude evaluation beneath the effluent management dam indicated low hydraulic conductivity conditions, with high water quality estimates suggesting no current leaching. This integrated modelling supports nutrient management planning and compliance.

Riverbank stability assessment



Density modelling identified low-density soils associated with elevated bank collapse risk. Moderate and high-risk zones were mapped to assist with erosion mitigation and infrastructure planning.

Yield estimates and well design recommendations



Yield modelling was undertaken for 100 m, 200 m, and 300 m well screens.

- 100 m screens: Sustainable yields 4.2–5.7 L/s
- 200 m screens: Sustainable yields 6.9–7.2 L/s
- 300 m screens: Sustainable yields 8.8–9.0 L/s

Increasing depth improves yield potential but introduces higher uncertainty and cost considerations. Risk and interpretation confidence metrics were incorporated to support transparent decision-making.

Implications for hydrology practice in New Zealand

This case study illustrates the value of integrated geophysical approaches in farm-scale groundwater management. Three-dimensional modelling enhances understanding of aquifer architecture, improves stakeholder communication, and supports science-based resource management decisions.

Conclusion

The Owl Farm Survey highlights how modern geophysical aquifer modelling can bridge hydrogeology, agriculture, and environmental stewardship. As water management frameworks evolve in New Zealand, integrated modelling approaches will play an increasingly important role in sustainable groundwater development.

Author contact

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ARTICLE

What northern NZ's wet and sticky summer reveals about our warming atmosphere

By Kevin Trenberth, University of Auckland

New Zealand's summer has been defined by repeated bursts of intense rain, as subtropical systems have swept down over the upper North Island and beyond.

Floods, slips and storm damage have dominated the headlines. But many of the season's events have come with another feature we rarely talk about: the sheer amount of moisture in the air before the rain even starts.

Even by Auckland's standards, recent humidity readings have been notable.

On February 2, the Whangaparaoa automatic weather station on the city's North Shore recorded a temperature of 24°C with 98% relative humidity. That implied the dew point – a direct measure of humidity – also came close to 24°C, making for conditions not merely muggy, but oppressive.

A fortnight earlier, on January 21–22, humidity in Tauranga reached similarly sticky levels, with dew point measuring 20°C to 24°C. Over that period, a record-breaking 274mm of rain fell within 24 hours, triggering separate landslides that claimed eight lives.

While humidity is often treated as just an uncomfortable part of summer in the upper North Island, it can, like extreme rainfall, tell us something important about the warming state of our atmosphere.

It also presents a real risk to human health that can be overlooked when we focus on temperature alone.

Why heat feels worse when the air is wet

Over summer, weather reports and television forecasts typically focus on maximum temperature and almost never mention humidity in any form. Yet it is a major factor in New Zealand's weather – and our comfort depends on it as much as on temperature.

Our bodies continuously exchange heat with the environment through conduction, convection, radiation and evaporation. Humidity strongly influences how effective the body's natural cooling systems are – particularly sweating – and this becomes critical at higher temperatures.

The range where most people feel comfortable is roughly between 22°C and 27°C, when humidity is favourable.

Typically, humidity is expressed as relative humidity, which gives the percentage of moisture in the air compared with the maximum it could hold at that temperature. But this measure goes up and down with temperature, while the moisture content of air does not.

A far better indicator is the dew point, the temperature at which air becomes saturated and water vapour begins to condense.

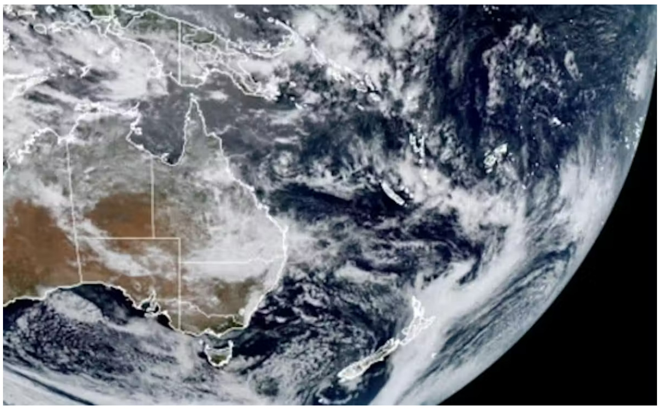
Most people start to feel uncomfortable when the dew point rises above about 16°C and conditions can become difficult to bear above 21°C. A high dew point means sweat evaporates poorly and heat stress increases. A day that is 30°C can feel pleasant in dry air, but hard to handle in humid air.

When temperatures reach extreme levels, however, even very dry air can become dangerous. Amid a recent heatwave in southeast Australia, Melbourne recorded maximum temperatures of 41°C and 43°C on January 7 and 9 respectively, with some western and northern suburbs exceeding 45°C.

Despite relative humidities of around 15% and a dew point of less than 12°C, the heat was still extreme. Evaporative cooling still occurs, but at these temperatures the human body can still be overwhelmed.

A climate change calling card

Owing to its maritime climate, New Zealand seldom experiences temperatures above 30°C. When these do occur, they mainly come amid dry north-westerly flows in eastern parts of the country, such as Canterbury and Hawke's Bay.



A moisture-laden weather system that began as an atmospheric river, observed by the Japanese Meteorological Agency's Himawari satellites, hangs over New Zealand on February 14. JMA, CC BY-NC-ND

In summer, the upper North Island is much more used to background humidity. In Auckland, for instance, the dew point typically hovers between 17°C and 18°C, which is noticeable but not oppressive. On very humid days, often with northerly winds, those values can easily exceed 20°C.

This is just what people experienced in late January when a series of storms passed across the region, bringing intense rain and moisture. These events happened to come as part of a wider "atmospheric river" – long, thin filaments of atmospheric moisture that can stretch thousands of kilometres from the subtropics to New Zealand.

Over recent years, these systems have been responsible for some of the country's most damaging weather events. As the climate warms, the atmosphere can hold more moisture, meaning atmospheric river events are likely to grow even more frequent and intense, while also raising health risks that come with high humidity.
Another reason for the run of wet and humid weather this summer has been the influence of a fading La Niña climate pattern, which favours warmer seas around New Zealand and more frequent subtropical flows from the north.

Besides driving up local humidity levels, these visiting weather systems can worsen the risk of landslips and landslides – particularly when they bring sudden, heavy downpours after long dry spells have left the ground cracked and vulnerable. In the East Cape region, more than 11,000 slips and landslides were recorded in January alone.

All of this means humidity is more than a source of discomfort and potential heat stress, but an early warning signal of a moisture-laden atmosphere and the risks that come with it.

As our planet continues to heat, measuring and reporting dew point, in both New Zealand and Australia, should become the norm.

ARTICLE

Low-cost measurement of river flow and depth

Aimee Williamson, Aashish Khadka, Fabio Silveira, Daniel van der Walt and Markus Pahlow
Department of Civil and Environmental Engineering, University of Canterbury

Accurate information about how much water flows through rivers is essential for flood management, irrigation planning, environmental protection, and infrastructure design. However, traditional methods often require expensive equipment, trained personnel, and direct access to the river, which can be difficult or unsafe during high flows or at remote sites.

To address these challenges, researchers from the University of Canterbury investigated whether river flow can be measured accurately using low-cost sensors and open-source software. The study explored a video-based technique known as Large-Scale Particle Image Velocimetry (LSPIV) as a practical and affordable alternative for estimating river discharge under field conditions.

What was tested in this study?

The focus of this study was to determine river flow and at the same time water level using pyOpenRiverCam (pyORC), an open-source software tool that applies LSPIV to short video recordings of rivers. Field testing was carried out at river sites in Canterbury, including the Cam / Ruataniwha River, where Environment Canterbury flow data were available. Selecting a site with an existing gauge allowed for an investigation of how various aspects of the camera-based estimates affect accuracy, with a comparison against reference measurements.

How does the video-based method work?

Before flow measurements could be made, the camera first had to be calibrated. This was done using Ground Control Points (GCPs), which are clearly visible reference points along the riverbanks with known real-world locations. Identifying these points allows the software to understand the scale and perspective of the camera view.

Once the camera was calibrated, short videos of the river surface were recorded. These videos were then analysed using pyORC, which translated the motion visible in the footage into estimates of surface water velocity across the river width. An example velocity profile generated using pyORC is shown in Figure 1.

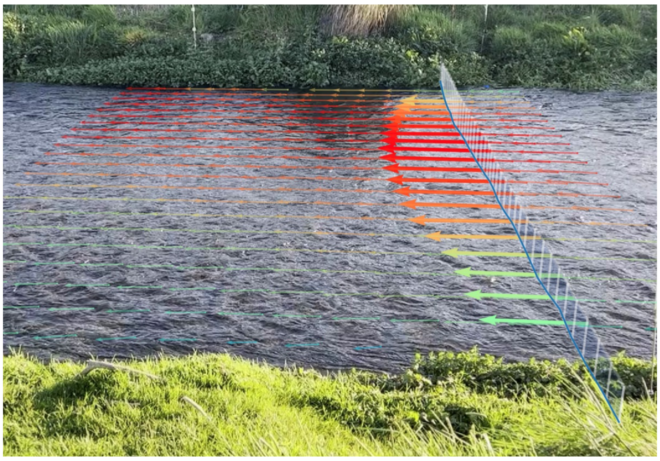


Figure 1. Cross-section velocity profiles at Cam / Ruataniwha River in Canterbury.

The calibration only needs to be completed once for a fixed camera position, meaning that repeated measurements can be made efficiently without recalibrating each time.

What affects accuracy?

A key aim of the research was to understand which practical factors when implementing this low-cost system in the field influence the accuracy of flow estimates. The results showed that camera placement is critical. Cameras positioned perpendicular to the river channel produced more reliable results than those placed at oblique or near-parallel angles. Footage captured from directly above the river, for example using a drone or from a bridge, produced the most accurate estimates because this perspective minimised image distortion.

The length of video recordings was also examined. Flow estimates stabilised after approximately ten seconds of footage, with longer videos providing little additional improvement. This finding is important for practical applications, as it shows that short recordings intervals are sufficient for reliable analysis. This substantially reduces the data storage requirements.

Lighting conditions strongly influenced accuracy: bright sunlight improved the visibility of surface features, while cloudy or shaded conditions reduced performance, especially on smooth water surfaces. Flow magnitude was less important than surface texture with ripples or turbulence producing reliable results.

Measuring water level

Both pyOpenRiverCam's camera-based optical water-level detection and a low-cost Arduino-based distance sensor were tested. The study found that achieving consistent and reliable water-level measurements under real field conditions is still challenging using these techniques. Optical detection from video imagery was frequently affected by shadows, vegetation, wet riverbanks, and irregular channel geometry, leading to unreliable estimates. The Arduino distance sensor produced acceptable results only when installed close to the water surface and aligned nearly vertically, with accuracy declining rapidly as installation height and angle increased. Together, these findings highlight water-level measurement as a key remaining limitation for video-based river discharge estimation and a priority for future development.

What does this mean for river monitoring?

The results show that a video-based method can provide reliable flow estimates using short recordings and simple camera setups, making them practical for monitoring without the need for expensive equipment or in-stream measurements. This approach offers a safe, low-cost, low data storage, non-contact option for routine monitoring, particularly at sites that are difficult to access, hazardous during high flows, or costly to instrument using conventional methods.

Acknowledgements

Financial support from the New Zealand Hydrological Society Research Grant is gratefully acknowledged.

We are also gratefully acknowledge that pyORC has provided open access by Rainbow Sensing in the Netherlands: Introduction: pyOpenRiverCam in a nutshell:
https://localdevices.github.io/pyorc/intro.html.

We thank the team at Environment Canterbury for providing river flow data used in this study.

ARTICLE

Aqua Intel Aotearoa (AIA) Programme Summary

By Maïwenn Herpe (Earth Sciences NZ), Stew Cameron (Earth Sciences NZ) and Zara Rawlinson (Earth Sciences NZ)

Aqua Intel Aotearoa (AIA) has delivered an innovative programme to improve understanding of New Zealand's water availability and storage, with Aerial Electromagnetic Mapping (AEM) as its centrepiece. Co-led by ESNZ (formerly GNS Science) and Kānoa – Regional Economic Development and Investment Unit, AIA worked across Northland, Gisborne, Southland, and Otago, with a focus on investigating groundwater storage, aquifer geometry, surface-groundwater interaction, and opportunities for natural or constructed water storage.

The programme utilised cutting-edge technology (AEM SkyTEM), acquired from Australia and Denmark, to rapidly and cost-effectively map and characterise large areas of groundwater systems in 3D to a resolution and depth not achievable by traditional methods such as drilling or ground-based investigations. Such surveying was undertaken in Northland, Southland and Gisborne.

By harnessing this technology in combination with ESNZ's hydrological science expertise, and working through key partnerships with councils and iwi Māori, AIA developed recommendations for short-term and future water management initiatives. From finding more water potentially available for allocation in three of the regions, to identifying a more widespread salinity challenge in another, the programme generated key insights for sustainable water use.

The programme has been highly successful and valued by the regions. The insights generated are already informing water allocation and resource consent decisions and provide a foundation for further scientific investigations into the impacts of future climate change and land use changes on water availability. AIA will continue to have a legacy guiding high-quality water management decisions in coming years, as councils incorporate the outputs into modelling and water allocation frameworks.

Engagement was at the heart of AIA from the start, with the team working with councils, iwi Māori, local experts and interest groups to determine the 12 projects that would be undertaken under the programme (Figure 1). This ensured that the investigations were directed at addressing the questions most relevant for water management issues for each region (Table 1).

The feasibility of new water storage solutions was explored as part of the programme, including high-flow harvesting, wetland augmentation, and reservoir construction. By identifying these opportunities and providing targeted solutions for each region, AIA has enabled councils to take the first step towards innovative solutions to address the water security challenges in their regions.

The AEM technology has proven to be highly effective in providing very high-quality information for mapping groundwater systems and providing information suitable to be used within subsequent pieces of work such as water budgets and allocation models. The programme has established a wider base of experienced capability in NZ that can be readily applied to other regions.

All reports are listed below and will be available on the ESNZ website in due course. For any queries, please contact Stew Cameron.

Table 1: Key regional outcomes

	Context	Investigations	Key Findings/Outcomes	Next steps
Northland	Hydrologically complex: short rivers, sand and basalt aquifers Frequent droughts and floods Saline intrusion risk in coastal aquifers Māori land development constrained by water availability	Te Hiku Water Study: 6,471 km AEM mapping of Aupōuri aquifer and groundwater drilling Groundwater drilling at Poutō Surface-flow monitoring near Māori land High-flow harvesting study	Groundwater system larger than thought. Salinity is from deep geological structures, not shallow coastal inflow Surface water likely to be available for whenua Māori development Groundwater potentially available for Te Uri o Hau Harvesting high surface water flows feasible with appropriate allocation framework	Integrate AEM into NRC allocation models Investigate North Cape groundwater potential Support construction of Far North reservoir Further develop ESNZ high-flow harvesting framework for implementation within allocation policies Continued monitoring of groundwater with Te Uri o Hau and surface water with land Trusts
Gisborne	Erosion-prone hill country, fertile flats Climate change intensifies drought/flood risk Surface water and Poverty Bay groundwater heavily allocated Limited East Coast aquifer information	AEM surveys of Poverty Bay Flats and East Coast: 3,624 km. Water budget modeling: groundwater drilling, surface water monitoring, synoptic gauging High-flow harvesting study	More salinity in Poverty Bay aquifer caused by deep geological structures; aquifers connected; more capacity for potentially taking water in some locations East Coast aquifers small, groundwater often brackish – no scope for large scale extraction Harvesting high surface water flows feasible with allocation framework	Integrate data into GDC allocation models Further develop ESNZ high-flow harvesting framework for implementation within allocation policies Consider water storage reservoir
Otago	Alpine rainfall vs dry inland basins (Central Otago driest) Historical reliance on surface abstraction Ecological pressures in key catchments	Assessment of the value of re-processing and re-interpretation of the Glass Earth FEM dataset (~52,000 km) - focus on Manuherikia–Ida valleys	Large zone of medium–high aquifer potential immediately northwest of Alexandra but very limited borehole confirmation Improved aquifer boundary delineation Better understanding of groundwater-surface water connections	Exploratory drilling in high-potential zones Extend re-processing and re-interpretation of Glass Earth FEM data to other areas, e.g. Maniototo and Cromwell basins Integrate datasets into numerical groundwater models and refine allocation frameworks
Southland	Abundant rainfall, connected waterbodies Seasonal shortages in northern Southland High potential for high-flow capture and wetland enhancement	AEM aquifer mapping (Mataura catchment): 5,300 km. Wetland augmentation modelling (SWAT)	More groundwater could be available in the Mataura without impacting Mataura River flows Groundwater system may extend further north and south Enhancing wetlands increases baseflows and surface-groundwater interaction, supporting higher levels of water abstraction	Hydrogeological interpretation of the AEM results and validate with drilling. Refine wetland modelling, incorporating additional focus areas to inform locations and scale of wetland enhancements.

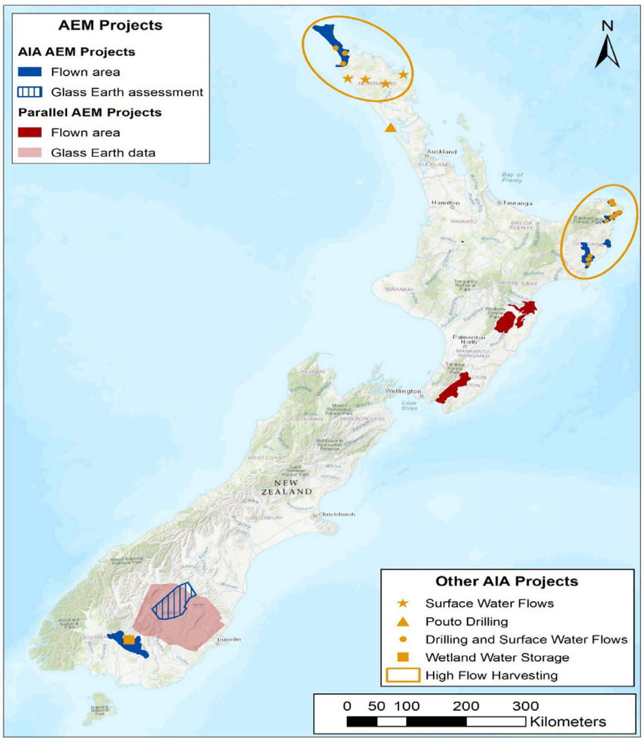


Figure 1: Activities undertaken by Aqua Intel Aotearoa and parallel aquifer mapping programmes

Individuals involved from AIA/ESNZ/MBIE

Jane Frances – Programme Director; **Ben Pasco** and **Damon Clark** – Programme Managers, **Dr Stewart Cameron** – Programme Leader

Programme Science Leadership and Researcher

Dr Richard Kellet, Dr Wes Kitlasten, Zara Rawlinson, Dr Rogier Westerhoff, Paul White.

Researcher

Dr Doug Booker, Thomas Brakenrig, Dr Lee Chambers, Dr Martin Crundwell, Henry Gard, Maïwenn Herpe, Dr Mark Lawrence, Dr Catherine Moore, Magali Moreau, Dr Uwe Morgenstern, Frederika Mourot, Maria Narvaiza, Dr Ehsan Qasemipour, Dr Tusar Sahoo, Estafania Santamaria Cerrutti, Phil Scadden, Dr Dominic Strogen, Mike Taves, Daniel Teka Berhe, Te Aomania Te Koa, Vanessa Trompetter.

Governance

Peter Benfell, Alan Coulson, Terraine Holli, Anup Mohan, Dr Joe Prebble, Dr Lucia Roncaglia, Siobhan Ryan, Chris Worts.

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ARTICLE

Art (and Science) of the water cycle

By Daniel Collins

Community engagement in decision-making around water resources or flooding requires a degree of hydrological literacy and receptivity. This can be difficult to achieve when hydrological knowledge is largely technical and the issues discussed contentious. One way to support this engagement is through art.

Art has long been used in the service of science, particularly before the invention of photography. When James Cook sailed his second voyage of circumnavigation aboard the Resolution, 1772-1775, he took with him artist William Hodges (Manatū Taonga - Ministry for Culture and Heritage, 2017). Hodges was tasked with making "drawings and paintings of such places in the countries we should touch at, as might be proper to give a more perfect idea thereof, than could be formed from written descriptions only". Hodge's art were geographical observations.

Over time, purposes of art have evolved, and now broadly include records of our relationships with landscapes, commentary, protest, conceptual exploration, and emotional engagement.

In this article I select six artworks that depict different aspects of the water cycle, and discuss how the artworks tie into hydrology and how they might be used to connect audiences to hydrology alongside more scientific information.

Clouds and precipitation

As is perhaps conventional in hydrological explanations of the water cycle, I start this article in the sky. Clouds and rain are frequent features of landscape art, either as a backdrop or a key element.

'On the Wilberforce River near Bond's Station' by Thomas Cousins (1889) (Fig. 1) contrasts the turbulent Canterbury river with gentle rain falling in the mid-ground, and snow on the peaks. While Cousins may have been driven to capture a scene of beauty, the painting can also serve as an illustration of mountain hydrology, where river flow is fed by rain and snowmelt.

Serendipitously, this is also the backdrop of Mona Anderson's book about mid-20th century station life, 'A River Rules My Life' (Anderson, 1963). In the book, Anderson distils the essence of mountain hydrology thus:

"The waters of the Wilberforce were locked up for the winter in the heavy matrices of snow and ice that rested on the mountains. Months later I was to see it with the spring thaw on its back - brown, ugly and raging, a killer river that no man in his senses would cross. Now it was a gentle murmuring stream."

Figure 1. On the Wilberforce River near Bond's Station. Thomas Cousins, 1889, watercolour, 310 x 460 mm. Christchurch Art Gallery Te Puna o Waiwhetū (2007/037).

Rainfall, of course, is not always so calm. In 'Summer Storm Near Wanaka', Doris Lusk (1962) (Fig. 2) depicts an intense storm, not in mm/hr as hydrologists may, but in bold brush strokes and a heavy colour palette. A sense of intensity may be more recognisable to more people through ink than numbers.

Figure 2. Summer Storm Near Wanaka. Doris Lusk, 1962, oil on board, 700 x 1030 mm. Christchurch Art Gallery Te Puna o Waiwhetū (2010/029).

Snow

Staying in the mountains, the watercolour painting by Olivia Spencer Bower (unknown date), 'Queenstown and the Lake from the Snowfields' (Fig. 3), demonstrates how artistic techniques can convey another physical quality. In this case: cold. The view is from Coronet Peak looking down to Lake Wakatipu in winter. Snow is lying on the peaks, but what conveys a sense of coldness is not measurements in °C, but rather cool hues of blue and grey. Again, a physical sense is achieved through colour.

Rivers

Following the flow of water down from the mountains, rivers feature frequently in landscape art. Fig.1 already showed Canterbury's Wilberforce River. Another river of particular importance to Canterbury art is the West Coast's Otira.

The Otira River became the primary subject of Dutch painter Petrus van der Velden (Vangioni and Dekkers, 2011). van der Velden arrived in Christchurch from the Netherlands in 1890, and introduced the role of the professional artist. About the Otira landscape he wrote: "For the first three days I did nothing at all but just looked, it took my breath away." And through his painting he sought to capture the awe and grandeur of the river and mountains, particularly during storms and floods, as can be seen in Fig. 4. At over 1 m wide and high, the oil painting is even more imposing in person.

It is perhaps also interesting and sombre to note that on the trip to make preparatory sketches for 'Mount Rolleston and the Otira River', van der Velden and his travelling companions had to endure a severe June snowstorm, during which one of the number, Mr A. Aldersley, died. This leaves us open to wonder whether the painting is especially dark because of the sombre mood the painter may have been in at the time.

Figure 3. Queenstown and the Lake from the Snowfields. Olivia Spencer Bower, unknown date, watercolour and pencil, 330 x 430 mm. Christchurch Art Gallery Te Puna o Waiwhetū (76/27).

Figure 4. Mount Rolleston and the Otira River. Petrus van der Velden, 1893, oil on canvas, 1015 x 1700 mm. Christchurch Art Gallery Te Puna o Waiwhetū (69/144).

Flooding, this time in Southland, is also the subject of Maud Sherwood's (1947-48) 'Flood near Maitland' (Fig. 5). The scene is awash with water, in the cloudy sky above, and the inundated land below. Three buildings stand amidst the water, with a group of people, dwarfed by the flooding, getting about by boat. And yet, despite what was likely a stressful event for those concerned, the colours and brushwork evoke a sense of calm or neutrality. This contrasts with the awe of van der Velden's Otira.

Figure 5. Flood near Maitland. Maud Sherwood, 1947-48, watercolour, 457 x 610 mm. Te Papa (1960-0007-1).

The hydrosocial cycle

In art as in hydrology, work often centres on people's relationships with the environment. Both seek to explore how people may be affected by the environment, and how in turn we may affect the environment. We have seen a little of this already in artworks discussed above, but one particularly poignant piece is the print by Bing Dawe (1987), 'Gravy Boat 1' (Fig. 6).

Dawe produced this print while he was working at an abattoir. Depicted within the shape of a gravy boat at the top are animals being processed into meat. Depicted within the shape of a saucer below is a hydrosocial cycle. In the top left of the cycle we see a hydropower dam, generating electricity which is transmitted to the abattoir above. Water below the turbine enters a lake, some of which is diverted to border dyke irrigation on the bottom left. Sheep or cows may be in the field below that. Water also flows down a river, on the right, to the sea, and we can see migrating fish moving upstream. This image thus shows a number of ways in which society appropriates the water cycle for food production.

Figure 6. Gravy Boat 1, from Freezing works series: Designs for a dinner set. Bing Dawe, 1987, woodcut, 300 x 380 mm. Christchurch Art Gallery Te Puna o Waiwhetū (2004/52.1-14).

Practical advice for science communicators

As I have argued in this article, art can act as a powerful and emotional gateway for audiences to appreciate the water cycle. While hydrological science may focus on data, graphs, and models - subject matter that requires the 'logical' brain - neuroscience indicates that we can be primed to learn by first engaging with the subject emotionally (Tyng et al. 2017). Art can help provide this emotional and low-threshold hook (Zaelzer, 2020).

For those science communicators interested in using art to support their messages, I conclude with some practical guidance. Firstly, searching online catalogues of art galleries is an effective way to identify potentially useful artworks and artists. To use any artwork in a presentation or publication, you would need permission from the artist, artist's estate, and/or owner of the artwork (e.g. gallery). This may come at a cost, particularly if you want a high-resolution image. For fee-free use, Te Papa's online collection includes many artworks without any use restrictions. Finally, the artwork and copyright holder(s) must be acknowledged appropriately, as demonstrated throughout this article.

Acknowledgements

Permission to reproduce images has been kindly granted by Christchurch Art Gallery Te Puna o Waiwhetū and Te Papa. This article developed from a public talk I gave at the Christchurch Art Gallery Te Puna o Waiwhetū in July 2025 and a conference presentation I gave at NZHS's 2025 conference in Kirikiriroa, attendance at which was supported by a NZHS Travel Grant.

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UPDATE

Earth Sciences New Zealand update

Compiled by Rasool Porhemmat & Maïwenn Herpe

Staff news

Maria Narvaiza, who has been with ESNZ for two and a half years, has now accepted a permanent position. She has been working intensively on the SSIF-funded National Aquifer Mapping project, helping with the 3D facies modelling.

Connor Newman is joining ESNZ as a Senior Groundwater Modeller, moving to New Zealand from the United States and a previous position with the U.S. Geological Survey. Connor's research focuses on combining physical and geochemical data to jointly inform hydrologic models. Connor's recent studies have focused on geothermal resources, groundwater/surface-water interactions, acid mine drainage, and utilising environmental tracers such as noble gases, tritium, and stable isotopes to quantify groundwater ages and aquifer dynamics. Connor looks forward to contributing to diverse studies of New Zealand's water resources. For example, Connor will be working on the contaminant transport modelling case study for the MBIE Endeavour-funded Our Changing Coast programme. This case study focuses on a legacy landfill located on the Tiwai Peninsula, where the New Zealand's Aluminium smelter operates, and will investigate several key contaminants of concern. The transport modelling aims to assess the mobility of key contaminants under sea-level rise and climate change scenarios.

Future Proofing Groundwater Endeavour programme

This programme had a kick-off hui in April 2025 and will advance understanding of groundwater resilience through new characterisation and modelling approaches. It will develop adaptive management tools to secure freshwater health while supporting the primary sector under a changing climate. The programme brings together groundwater modellers, complex-system and policy scientists, researchers and mātauranga Māori experts from multiple international collaborators and domestic organisations including Lincoln Agritech, Scarletti, Victoria University of Wellington, Aqualinc and Land Water People. In a world first, this team of multi-disciplinary experts will develop an agile groundwater management framework based on up-to-date, context-specific understandings of: aquifer structure and storage parameters; groundwater age; recharge and flow rates; and nitrate assimilation capacity at catchment levels. Our Northland, Hawke's Bay, Waikato, Wairarapa and Canterbury case studies represent New Zealand's most productive aquifer systems and are places where drought and nitrate concentrations are of greatest concern. We will extrapolate from these, using new models, to identify: the groundwater systems most vulnerable to climate change; how climate change will alter groundwater quality, supply and demand; and feasible long- and short-term water and land-use management strategies.

This programme is led by Earth Sciences New Zealand and funded through the MBIE Endeavour Fund. Duration: 2024–2029. For more information, please contact Catherine Moore or Uwe Morgenstern.

New release for the Aotearoa New Zealand Hydrogeological Maps

The January 2026 update of the New Zealand Hydrogeological-Unit Map (HUM), a 2.5D GIS dataset (overlapping, stacked polygons) of hydrogeological units (i.e. aquifers, aquitards, aquicludes and basement) developed in a nationally seamless and consistent manner is now accessible here. This release is accessible free of charge and now also features geological and depositional facies for the 'basement' units at the outcrop and at depth (Figure 1). Geological and depositional facies are a key mapping component, providing information on spatial distribution and hydraulic properties of the units, such as thickness and hydraulic conductivity. In the long term, the HUM framework will build a 3D map of our groundwater systems.

In parallel to HUM mapping, 3D facies models have been developed using a consistent set of methods, for approximately 175 coastal systems. These models are developed with input from regional councils, and some of the were presented at the recent joint NZHS-NZMS conference in December 2025. Facies mapping is now starting for inland systems. These 3D models allow assessment of groundwater-flow pathways and understanding of controls on shallow flow provided by shallow aquicludes and can be used for multiple applications. For example, models will be relevant to groundwater supply, as coastal aquifers are one of the country's most heavily. used systems, as well as to climate change studies, as much the population lives close to the coast. In the long-term, 3D model data will be publicly available and referenced within the Hydrogeological Systems dataset.

For more information on the Hydrogeological Mapping project, contact [Stew Cameron.]

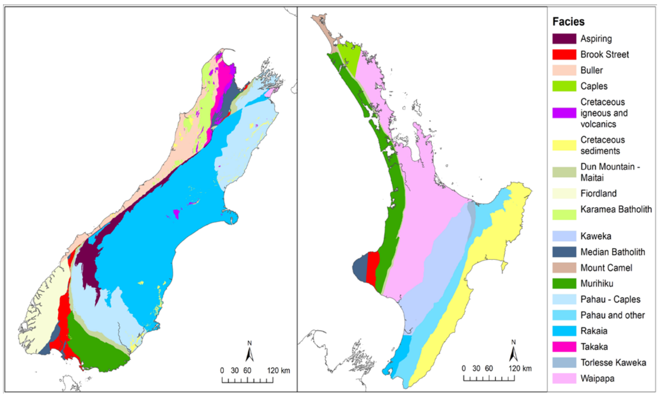


Figure 1: Basement facies for the Mesozoic and earlier HUM units (outcrop and at depth) included in the January 2026 dataset release.

Our Changing Coast (OCC) Endeavour programme update

The OCC programme is further developing an existing online tool (NZ SeaRise | Our Changing Coast), which combines sea-level rise projections with vertical land movement (subsidence and uplift) satellite data to model coastal change and inundation along Aotearoa New Zealand's coastline. Enhancements to the tool will include improved vertical land movement data extending up to 5 km inland from the coast, enabling more robust projections of coastal change and flooding. The programme will also incorporate national-scale groundwater level predictions to further strengthen understanding of coastal hazards for a wide range of stakeholders.

Development of the tool is being trialled through an initial case study in the Wellington region to assess the feasibility of applying an in-development methodology at a national scale. Delivered via the Takiwā platform, the interactive map will allow users to select coastal locations at improved spatial resolution to view coastal change and inundation hazards for various IPCC-SSP scenarios to the year 2150.

For more information, please contact Lee Chambers.

Extended Strahler ordering to distinguish mapped river channels from overland flow pathways and consistently compare digital river networks

ESNZ recently published a paper that devised the extended Strahler ordering system to be used in conjunction with multi-coloured digital river mapping (Figure 2). Five advantages to multi-coloured digital networks and the extended Strahler ordering system are:

- **Novel methodological contribution Extended Strahler ordering:** A new approach to the traditional Strahler stream order system by using non-positive values (0 and negative numbers) to represent overland flow pathways. This innovation enables clearer distinction between river channels and non-channel flow paths within digital drainage networks.

- **Improved network comparability:** The extended ordering allows consistent comparison of river networks created from different DEM resolutions or data sources, solving a long-standing issue where standard Strahler order values varied with DEM resolution or flow accumulation thresholds.

- **Integration of cartographic and DEM data:** High-resolution LiDAR-derived DEMs were combined with cartographic maps from LINZ to identify headwaters and sinkholes, enhancing network accuracy and realism in both mountainous and flat terrain.

- **Enhanced modelling applications:** The method facilitates multi-purpose hydrological and ecological modelling by distinguishing flow routes within river channels from overland flow pathways. It is applicable in flood modelling, biophysical simulations, groundwater-surface water coupling, and conservation assessments such as IUCN-GET (Global Ecosystem Typology) classification.

- **Automated and replicable workflow:** The workflow implemented using Whitebox tools and custom Python algorithms provides a transparent, reproducible, and adaptable framework for digital river network generation and analysis that can be extended to other GIS environments (e.g., GRASS, BasinMaker).

For more information, please contact Doug Booker; find the freely available published paper here.

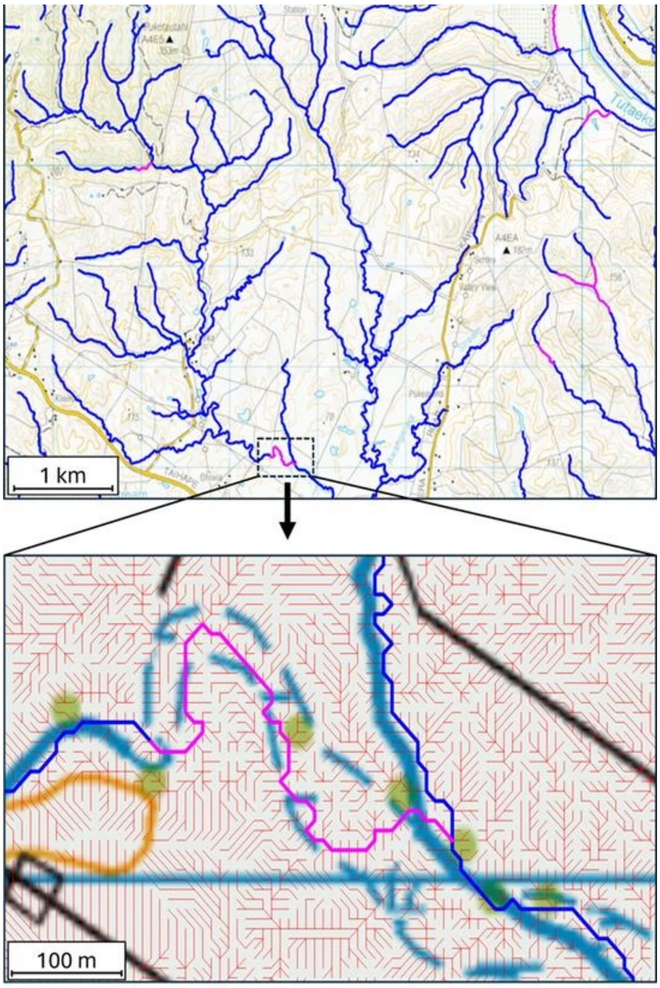


Figure 2. Network derived from an 8 m DEM showing blue (river channel), purple (overland flow pathways downstream of river channels) and red (overland flow pathways upstream of river channels) segments at two zoom levels. Purple segments in the lower plot are generated because the river channel passes into a sinkhole upstream of a swamp.

Complementary precipitation isotope models reveal young and new water fractions in New Zealand rivers

Improved knowledge of catchment transit times can enhance our understanding of hydrological and biogeochemical processes occurring in the sub-surface, and thus prediction of catchment responses to land use and global change. However, a lack of suitable precipitation tracer data in many areas worldwide hinders transit time assessment at large spatial scales.

We evaluated variation in young water fractions (F_{yw} – the fraction of streamflow less than 2.3 ± 0.8 months old) across 79 New Zealand catchments representing ~46% of New Zealand's total river discharge. Fyw was calculated using two precipitation isotope models: a seasonal kriging model and a machine-learning model (PINZ) trained to predict seasonal and non-seasonal variation. We also used data from PINZ to estimate monthly new water fractions (F_{new} – the fraction of streamflow derived from precipitation that fell within the past month) using ensemble hydrograph separation. Our primary goal was to assess the reliability of the two precipitation isotope models for transit time estimation across New Zealand, where non-seasonal variation in precipitation stable isotope values is prominent in some regions. To evaluate whether F_{yw} and F_{new} derived from the two precipitation isotope models captured meaningful variation in catchment hydrology, we tested for consistency of their associations with two established predictors of storage in the subsurface: catchment geology and baseflow recession constants (Figure 3).

Our results across all sites indicate that an average of 18% of river flow was younger than ~2.3 months, with 11% younger than one month. F_{yw} and F_{new} were similarly related to catchment geology, and gradients of baseflow recession constants. Kriging provided more accurate Fyw estimates than PINZ, which tended to underestimate extreme precipitation isotope values, leading to overestimates of Fyw. However, the PINZ model offered reliable estimates of F_{new} when robust estimation was used to reduce the influence of outliers; this held for sites where seasonal cycles were poorly defined, highlighting the potential for machine-learning precipitation isotope models to support transit time estimation in regions with weak seasonal isotope cycles, (e.g. in tropical or marine climates). This work also highlights the power of data-driven tools like machine learning to fill key environmental data gaps.

For more information, please contact **Bruce Dudley**; the freely available published article can be found here.

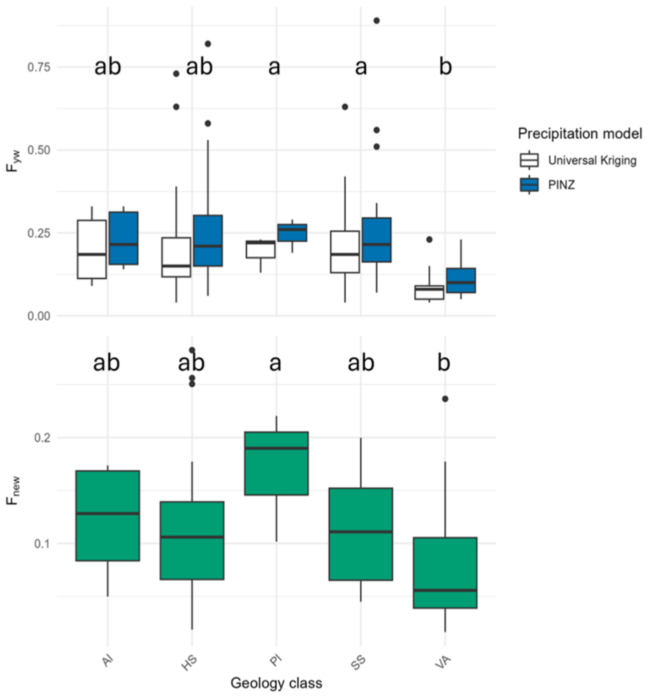


Figure 3. F_{yw} and F_{new} grouped according to simple classification of catchment geology. codes describing the dominant geology in the upstream catchment are derived from the river environment classification of snelder and biggs (2002), where al = alluvium, hs = hard sedimentary, pl = plutonic, ss = soft sedimentary, and va = volcanic acidic.

UPDATE

Aqualinc Update

Compiled by Kate Mason

Company Office Move

We are excited to welcome the new year and to begin a new era in the journey of Aqualinc Research Limited. We have moved to our brand-new offices at 2 Hazeldean Road, Addington —a vibrant space designed to spark creativity, and collaboration.

Certifications

Congratulations to Nicole Calder-Steele, who has recently qualified as a Certified Environmental Practitioner (CEnvP) – Aqualinc's first team member to achieve this certification!
Professional recognition such as CPEng and CEnvP shows evidence of real-world experience, enhances professional credibility (particularly important in situations such as hearing processes) and demonstrates a commitment to ethical conduct.

Obituary

We are deeply saddened to share the news of the passing of Dr. Nick Dudley Ward late last year.

Nick's dedication and the impact he made on our profession, both in consultancy and in academic research and teaching, will be remembered with gratitude.

Nick returned from Australia to join us as a Principal Engineer at Aqualinc in 2023, although a number of us in the company had known him long before that from previous roles. Most of Nick's time at Aqualinc was spent working on developing and testing geophysical and mathematical methods for measuring groundwater levels and the physical properties of groundwater systems, an area of work that he had developed a passion for while living in Australia. This work has applications in managing hazards related to interactions between groundwater and flooding, and also for resource management.

While at Aqualinc, Nick also made significant contributions to projects on assessing the potential impacts of climate change on infrastructure, and developing a finite-volume implementation of Richards equation for variably-saturated flow through soils under irrigation.

One of the main strengths that Nick will be remembered for was in mentoring younger colleagues, helping them to realise their potential as engineers and scientists. We offer our heartfelt condolences to his family, colleagues, and all who are feeling this loss.

New Recruits

Jan Diettrich

Jan and his family have recently moved back to New Zealand after several years back in Germany. Jan has several decades of experience as a data scientist and hydrologist with extensive experience in water resource modelling, environmental systems analysis, and the integration of large and complex datasets. His work focuses on understanding and quantifying hydrological processes such as river flows, groundwater dynamics, flood behaviour, and the impacts of water abstraction on ecosystems and water availability. Jan is currently working on our MPI-funded project Next Generation Tools for Irrigation Demand Management.

Projects

The Aqualinc team remains busy, working across a diverse range of activities including consenting projects for primary sector and Council clients, source-water risk assessments, fieldwork such as sampling, gauging, and effluent pond drop tests, as well as a number of ongoing research initiatives.

Fieldwork

We made the most of the summer sun this year by supporting our clients with a wide range of groundwater quality monitoring and compliance requirements. Alongside our routine sampling rounds, this season presented several interesting technical challenges, particularly at sites with monitoring bores of significant depth and exceptionally deep water levels. In some cases, water levels extended beyond the practical limits of most standard, cost effective sampling methods available on the market. This pushed us to explore and test alternative approaches that could remain both practical and financially viable while still meeting our clients' regulatory commitments.

As part of this work, we have been assessing whether certain "grab sampling" techniques, typically not considered suitable for groundwater, might provide representative results in Canterbury's unique hydrogeological setting. Because the region's aquifer systems have high throughflow, the natural flushing of the water column in bores may allow grab-style sampling to perform comparably to more established methods such as purging three well volumes or low-flow sampling. Our comparisons to date have been promising, offering insight into where simplified methods may be appropriate without compromising data quality.

Effluent pond drop tests (PDTs) have also been continuing. We're able to undertake dairy effluent pond drop tests at any time of the year (including during milking) by leveraging real-time telemetry. Our telemetered loggers allow continuous monitoring of pond levels and weather conditions from the office, enabling tests to be actively managed as they run.

Leaking effluent ponds can be a significant source of contaminants to groundwater systems, and the best-practice guidance for leakage testing sets a high bar for measurement and analysis accuracy. To ensure robust and defensible results, we collect a comprehensive suite of data, including:

- Pond level and temperature
- Evaporation rate
- Wind speed and direction
- Light intensity
- Air temperature and humidity
- Atmospheric pressure
- Rainfall

This level of detail provides a clear understanding of pond behaviour and gives clients confidence that testing is being carried out to a high technical standard.

UPDATE

Update from PHF Science's

Groundwater and Environmental Microbial Solutions and Circular Economy Team

Compiled by Laura Banasiak

Groundwater Tracer Test at Burnham – Understanding Contaminant Transport

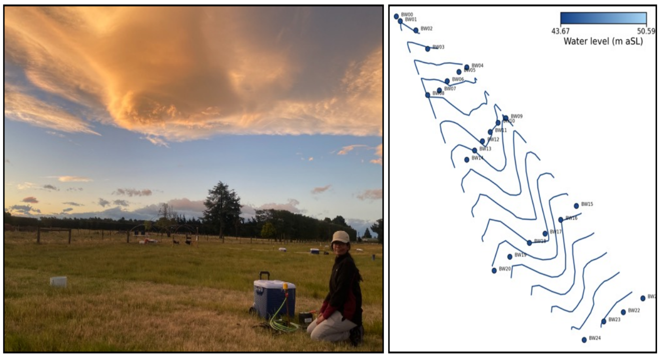
Late last year, the Groundwater and Microbial Solutions teams ran an intensive groundwater tracer test at the PHF Burnham site. The experiment examined how microbial contaminants move through an alluvial gravel aquifer, helping improve our understanding of groundwater risks and how to better protect public health.

Over two days, the team injected DNA surrogates (designed by Liping Pang) and microbial indicators into the aquifer and monitored their movement in high-frequency samples. These insights are key for managing contamination risks, safeguarding drinking-water supplies, and informing land-use decisions.

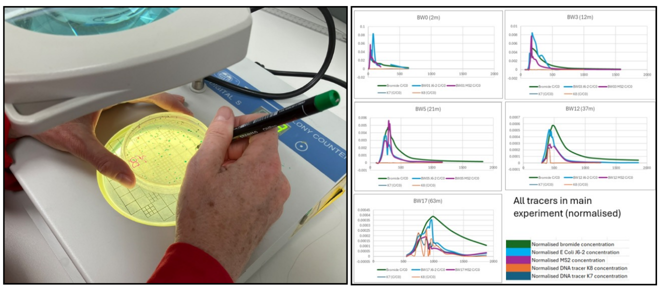
Around 14 staff contributed to this complex, carefully coordinated test. Despite long days, tricky weather, and real-time monitoring challenges, the collaboration was seamless and the experiment successful. We are now analysing the results to support our modelling work.

PHF Science maintains several instrumented groundwater field sites with long-term monitoring bore networks and high-quality datasets. These world-class sites support detailed investigations that improve understanding of groundwater systems and help protect community water resources. Our ability to continue funding them is limited, so we welcome interest in co-funding or using these sites for future investigations. Contact: Phillip.Abraham@phfscience.nz or Laura.Banasiak@phfscience.nz

Above: Sujani and Liping doing the field sampling and taking a rest on the overnight shift.



Above: Burnham field site – tracer experiment sampling under a Big Canterbury NW arch sky



Above: Counting the bugs and some preliminary results

Characterising the biological processes in a woodchip bioreactor

Microbial phosphorus cycling is another important process that may occur within the Barker's woodchip bioreactor and contribute to the observed reduction in phosphorus concentrations observed at the South Island site. Microorganisms inhabiting the woodchip can take up dissolved phosphorus and incorporate it into biomass, temporarily sequestering the phosphorus within microbial cells and the surrounding biofilm. As the biofilm matures, microbial by-products (e.g., extracellular bacterial polymers) can also bind phosphorus, further enhancing retention.

To measure the functional potential of the biofilm within the bioreactor, we have used metagenomic sequencing to identify microbes capable of assimilating dissolved phosphorus into biomass, producing extracellular polymers that bind P, or modulating redox conditions in ways that influence P sorption and release (Duggan, et. al., 2024). Linking this to previously collected chemistry data we will link the spatial patterns to the organisms present and their key role in the bioreactor in relation to P cycling.

References

Duggan DiDominic, K. L., Shapleigh, J. P., Walter, M. T., Wang, Y. S., Reid, M. C., & Regan, J. M. (2024). Microbial diversity and gene abundance in denitrifying bioreactors: A comparison of the woodchip surface biofilm versus the interior wood matrix. Journal of Environmental Quality. https://doi.org/10.1002/jeq2.20600

Groundwater Safety in a Warming World

As the climate warms, groundwater will play an increasingly significant role in climate adaptation, yet the vulnerability of Aotearoa's aquifers is poorly understood. Our SSIF project (started July 2023) is developing new methods to quantify climate change impacts on groundwater and connected surface waters across three areas: (1) climate driven changes to recharge, water tables, and flow dynamics; (2) the effects of increased groundwater salinity (within the freshwater range; <1500 µS/cm) on pathogen survival and transport; and (3) the influence of sea level rise on saline intrusion in coastal aquifers.

Since the previous update, we have completed the first experiment for component (2), with a second experiment on transport potential now underway. For component (3), we have submitted a paper presenting a national-scale model that uses water-level monitoring data and projected sea-level rise to assess coastal salinity risk.

To evaluate how slight increases in salinity affect pathogen persistence, we ran groundwater mesocosms at three salinity levels and two temperatures (14 °C and 20 °C). Four microorganisms were tested (Campylobacter jejuni, Escherichia coli, enterococci, and bacteriophage MS2). MS2 bacteriophage showed consistent survival across all treatments, suggesting suitability as a future faecal indicator. C. jejuni survived poorly, while E. coli showed enhanced survival at low salinity (~400 µS/cm), indicating that mild saline intrusion may increase its persistence.

A second experiment used gravel-packed columns (See photo) to assess the transport of E. coli and enterococci under three salinity levels at 14 °C. After establishing biofilm over several months, columns received salt amended or unamended groundwater before being dosed with microbial tracers following a Rhodamine breakthrough test. Data analysis is in progress, but we aim to determine whether increased salinity alters biofilm development and, in turn, accelerates microbial transport through aquifer material. Further assessment of biofilm dynamics, attenuation, and microbial retention within the gravel matrix is ongoing.

Pathogens in Groundwater – using novel surrogates, modelling, and data science to understand their fate and transport in aquifers

Groundwater is a critical source of drinking water in New Zealand and internationally, and understanding how pathogens move through vulnerable aquifer systems is essential for protecting public health. This project (started July 2024) builds on previous work to quantify pathogen transport in groundwater using novel surrogates and advanced modelling techniques.

Following the successful completion of our preliminary large-scale tracer experiment at the Burnham experimental site in late 2024, we have now completed our second large-scale multi-tracer field experiment at the PHF Burnham experimental site in late 2025. Over two intensive field days, approximately 14 staff from the Groundwater and Microbial Solutions teams injected engineered DNA surrogates, microbial indicator organisms, and conservative tracers into a highly heterogeneous alluvial gravel aquifer, with high-frequency monitoring undertaken across multiple wells. Microbial samples were transported for time-sensitive laboratory culture analysis, while the engineered DNA surrogates were quantified using qPCR methods. We are now analysing the field and laboratory data to support subsequent modelling and risk assessment work.

This was a complex and carefully orchestrated field campaign, requiring real-time coordination of injection systems, monitoring equipment, and laboratory logistics under variable weather conditions. The successful completion of this experiment represents a significant milestone for the project and provides a robust foundation for ongoing modelling work aimed at improving understanding of pathogen risks in vulnerable groundwater systems.

Field site and laboratory work during the 2025 multi-tracer experiment. Left and centre: field setup and sampling at the Burnham alluvial gravel aquifer field site. Right: laboratory staff processing microbial and DNA samples.

Groundwater Health Index – using biological data to determine contaminant presence and changes to the water quality

MfE-supported research by Louise Weaver's team at PHF Science on uncommon aquifers (those not previously studied), specifically fractured basalt and coarse sand systems, reveals distinct biological communities that differ markedly from those documented in New Zealand's wider national groundwater dataset, which has historically focused on major, high-use aquifers. The study found significant variation in organismal assemblages across aquifer types, demonstrating that these less-studied systems host unique biodiversity not captured in existing national records.

This contrasts with the broader national dataset's emphasis on common aquifers, leaving critical gaps in understanding ecosystem variability. By filling these gaps, the uncommon aquifer data provide essential baseline information needed to develop accurate, ecosystem-based groundwater assessment tools.

The importance of this work is substantial: without incorporating the biodiversity of uncommon aquifers, national monitoring frameworks risk overlooking vulnerable ecosystems, underestimating ecological change, and misinforming policy. These new insights strengthen the scientific foundation of future groundwater health indices and regulatory guidance.

Weaver, L., Bolton, A., & Abraham, P. (2024). Groundwater Ecosystems: Preliminary Biodiversity of Uncommon Aquifers (Fractured Basalt and Coarse Sand). ESR Report for the New Zealand Ministry for the Environment (MfE).

This update summarises recent research on the diversity of microfauna and macrofauna in groundwater systems. The study examined their ecological roles and correlations with physico-chemical parameters across multiple aquifers. Seasonal shifts in biodiversity and their potential implications under future climate scenarios were also evaluated. To encompass a wide range of taxa, methods included environmental DNA (eDNA) analysis, specimen collection, and microbial culture, following protocols established through collaboration between PHF Science and the University of Auckland. Laboratory procedures involved taxonomic identification, eDNA sequencing targeting 16s, 18s, and ITS2 regions via Illumina MiSeq, bacterial culturing, and water chemistry assessments. Results indicated a high but decreasing abundance of microorganisms with depth and macrofaunal diversity influenced by depth and lithology. Seasonal variation was observed mostly in fungal presence, with limited changes in microbial and macrofaunal diversity. The findings highlight the importance of temporal studies to enhance understanding of groundwater ecosystems and improve predictions of their responses to land use and climate change.

Our work in the Pacific

Hydrogen Sulphide (H_2S) in Feedwater – Betio Desalination Plant, Kiribati

An investigation was conducted to determine the presence and causes of hydrogen sulphide (H_2S) in the groundwater supplying the Betio Desalination Plant under the South Tarawa Water Supply Project (STWSP). The work focused on identifying the factors contributing to H_2S formation—environmental conditions within the aquifer, mechanical and operational aspects of the production bores, and chemical processes promoting sulphide generation. The assessment also identified indicators that may signal future H_2S occurrence to support improved monitoring and early detection.

Findings were summarised in a comprehensive report outlining key conclusions and providing targeted recommendations. These include the monitoring, technical inputs, and operational practices required to effectively manage and mitigate H_2S risks for the sustainable operation of the plant.

STWSP – Groundwater Management Review and Options Assessment

Under the STWSP, PHF Science provided specialist groundwater expertise to review groundwater management practices and identify viable management options. The review strengthened understanding of the freshwater lens system, abstraction impacts, and long term sustainability across the project area.
The work included a technical assessment of hydrogeological data, bore performance, abstraction rates, salinity trends, and the existing monitoring programme. Current management practices were evaluated against best-practice principles for atoll groundwater systems, with attention to recharge, climate variability, sea level influence, saline intrusion, bore field operation, and pumping regimes.
Based on this assessment, PHF Science identified practical groundwater management options to improve sustainability, protect water quality, and optimise yield. These included refined abstraction strategies, improved monitoring and adaptive triggers, bore field optimisation, and strengthened data management, alongside consideration of institutional capacity and training requirements to support implementation.

Recent publications and outputs

Saccò, M., Mammola, S., Altermatt, F., ... Weaver, L..... et al. 2024. Groundwater is a hidden global keystone ecosystem. Glob. Change Biol., 30(1), e17066.

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Pang, L., Issler, T., Robson, B., Sutton, R., Lin, S., Allmendinger, J., Ariyadasa, S., Premaratne, A., Billington, C., Prenner, E.J. 2025. DNA-labeled chitosan nanoparticles: A potential new surrogate for assessing rotavirus attenuation and transport in sand filtration water treatment. Environmental Research, 264, Part 1, 120378. https://doi.org/10.1016/j.envres.2024.120378.

Pölz, A., Blaschke, A.P., Demeter, K., Blöschl, G., Stevenson, M.E., Bauer, H., Pang, L., Farnleitner, A.H. and Derx, J., 2026. Improving transparency in karst spring discharge and water quality forecasts using interpretable machine learning models in the Eastern Alps. Journal of Hydrology: Regional Studies, 64, p.103147.

Webber, J., Dost, K., Sarris, T., Wicker, J., Weaver, L. 2025. Using microbial community shifts to predict changes in water quality. Poster presented at the International Water Association (IWA) Health-Related Water Microbiology (HRWM) Conference, Amersfoort, The Netherlands, June 2025.

Weaver, L., Webber, J., Bolton, A., Sitthirit, P., Abraham, P., Masterton, H., Close, M. (2024). Groundwater Ecosystems: Preliminary Biodiversity of Uncommon Aquifers – Fractured Basalt and Coarse Sand. Ministry for the Environment. Client Report No. FW 24037. Retrieved from https://environment.govt.nz/assets/publications/biodiversity/groundwater_ecosystems_preliminary_biodiversity_of_uncommon_aquifers_fractured_basalt_and_coarse_sand.pdf

Weaver, L., Webber, J., Abraham, P., Bolton, A., Sitthirit, P., Close, M. (2024). Groundwater Diversity Across New Zealand: From Micro to Macro-scale. ARPHA Conference Abstracts. DOI:10.3897/aca.6.e108433.

Mosley, L., Weaver, L., Close, M., et al. (2024). Metabolic Diversity and Aero-tolerance in Anammox Bacteria from Geochemically Distinct Aquifers. Environmental Microbiology, 7(1). https://doi.org/10.1128/msystems.01255-21.

Ariyadasa, S., van Hamelsveld, S., Taylor, W., Lin, S., Sitthirit, P., Pang, L., Billington, C., Weaver, L. 2024. Diversity of Free-Living Amoebae in New Zealand Groundwater and Their Ability to Feed on Legionella pneumophila. Pathogens, 13(8): 665.

UPDATE

Lincoln Agritech

Compiled by Juliet Clague

Emerging Climatic Pressures Programme

Our team involved in the MBIE-funded Emerging Climatic Pressures Programme, led by Dr Adam Hartland, has been busy collecting field data over the summer months. We have met with Tūwharetoa Māori Trust Board and Ngā Kaihautū Committee representatives (Figure 1) to gain their endorsement of our mahi, and to collect water chemistry data and samples of the Waikato River as it leaves Lake Taupō (Figure 2), using our ¼-scale jet boat and a remote-deployed sampler. This information will provide a contrast with the data collected downstream, in particular from the geothermally influenced reach around Ohaaki.

Figure 1: Lincoln Agritech staff, University of Waikato PhD students and representatives from Tūwharetoa at Lake Taupō, February 2026.

Figure 2: *The ¼-scale jet boat takes continuous water quality readings and can be triggered to take a sample at any distance.*

The programme is also funding University of Waikato PhD student Jade Arnold's work, focused on capturing water quality and velocity information in the top 2 m of the water column. She will use a specially designed drifter (Figure 3) which floats with the water current and takes continuous water quality and velocity measurements. The instrument package is suspended 1.6 m below the surface, and measurements will be made at several locations along the length of the river. A GPS unit installed at the surface enables easy tracking and plotting of the data. The deployment boat follows the drifter 20–60 m behind, ensuring measurements are taken from undisturbed flow.

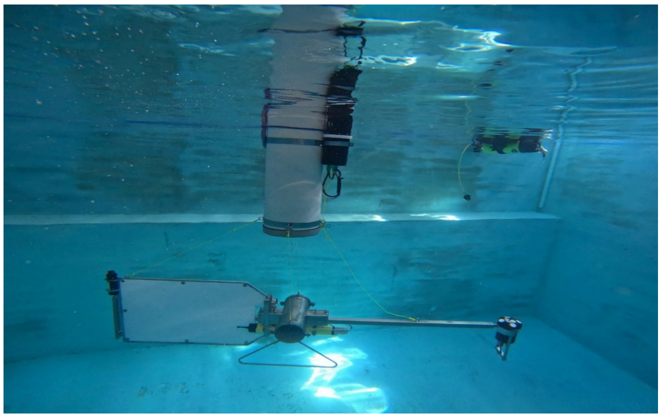


Figure 3: The drifter, with water quality sonde and ADCP installed (left) and GPS unit (right)

Whilst the ECP programme continues to examine future climate change pressures on the Waikato River, an emerging pest is having major impacts in the present. The instrumentation in place for the ECP programme is helping understand the impacts of the gold clam invasion which started with a detection in May 2023 in Lake Karapiro. The mollusc is now altering the river's chemistry in ways that could jeopardise drinking water for up to two million people, disrupt hydroelectric power and undermine decades of ecosystem restoration efforts. An Asian native, the gold clam can self-fertilise and spreads via contaminated gear, birds or floods. Climate change will likely accelerate its invasion.

Monitoring of the river has shown that by filtering water and building calcium carbonate shells, the clams have reduced dissolved calcium concentrations to about 25% below historical levels. Calcium is crucial for water treatment processes, helping to bind and remove contaminants such as arsenic. In late 2024, arsenic levels in treated Waikato water briefly exceeded safe limits of 0.01 mg/L, triggering alarms at treatment plants. While the exceedances were short-lived and were contained through rapid adjustments to treatment, they exposed vulnerabilities in a system optimised for historically consistent river chemistry.

These changes threaten more than water treatment. Clams could biofoul dam intakes and reduce hydroelectric efficiency in a river that generates 13% of New Zealand's power. Native species like kākahi (freshwater mussels) face competition and shifts in nutrient cycling could fuel algal blooms.

Interventions to reduce the spread of the clams is essential. Our research highlights the need for integrated action. Monitoring should expand, incorporating environmental DNA for early detection and calcium isotope tracing to pinpoint clam impacts.

Solutions must honour Te Tiriti o Waitangi principles. Collaboration with iwi and blending mātauranga Māori (indigenous knowledge) with science, such as using tikanga indicators for water health, is essential. Biosecurity measures including gear decontamination campaigns are critical to slow spread.

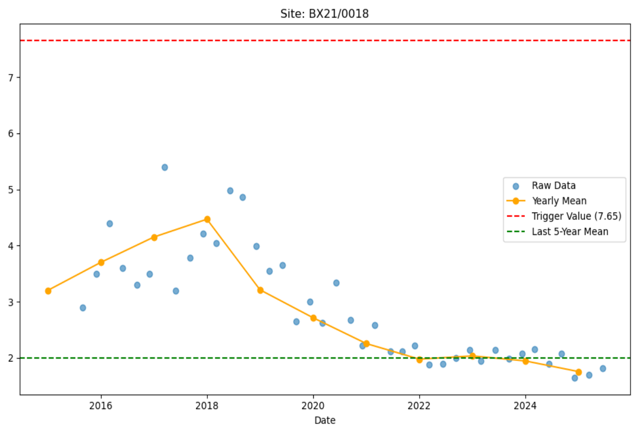
For more information on our work, Adam Hartland has written an article for "The Conversation" about the implications of the Corbicula invasion; the article is available at:

https://theconversation.com/gold-clam-invasion-in-nz-threatens-drinking-water-for-millions-of-people-270444

Central Plains Water nitrate trends

Central Plains Water Limited is an irrigation company in Canterbury, supplying water to > 46,000 ha of farmland. They have been tracking groundwater quality through monitoring of several wells across their scheme area over the past 10 years. We assessed the data in five-year increments and found that, in recent years, many wells had nitrate concentrations that showed a declining trend compared to earlier in the scheme's history. Between 2016 and 2020, only 10% of wells showed clear signs of declining nitrate concentrations, but between 2021 and 2025, this increased to 60% of wells. The downwards trend appears to have been influenced by both improved land use management and unusual climatic patterns in the early years of the scheme. In terms of land management, farmers within the scheme area have implemented numerous examples of good management practices, resulting in modelled Overseer nutrient losses being reduced by ~30%.

In terms of climate, the 2015 to 2017 period was very unusual, with two very dry winters, followed by a very wet winter in 2017. This high recharge winter resulted in a nitrate peak by the end of 2017/early 2018. Over the years since, nitrate concentrations in several wells have shown a downward trend.



Whilst there is a need for further investigation, the pattern we have seen in terms of nitrate concentrations provides some assurance that good land use management and mitigation practices might be resulting in positive outcomes.

Michael Rode – Helmholtz Institute

Lincoln Agritech have been fortunate to host Dr Michael Rode from the Helmholtz Institute in Germany. In collaboration with him, we are exploring how international best practice in hydrological observatories can inform the New Zealand context to explore how integrated, long-term monitoring infrastructure could strengthen climate resilience, water quality management, and modelling capability in Aotearoa.

Michael's work within the TERENO observatory network in Germany demonstrates how long-term, high-resolution monitoring across groundwater, vadose zone, surface water, and atmosphere can:

- Reveal climate-induced changes in nutrient cycling

- Strengthen calibration and testing of hydrological water quality models

- Support scenario analysis under major land cover change

- Provide forecasting capability grounded in process understanding.

UPDATE

WGA

Compiled by Cameron Jasper

Whakaoraā Te Waikēkēwai Wetland Baseline Streamflow Monitoring

Baseline streamflow monitoring has commenced this year for the Whakaoraā Te Waikēkēwai Wetland, an iwi-led restoration project at Te Pa o Moki Marae in Canterbury. The project is a collaboration between Te Taumutu Rūnanga, Wallbridge Gilbert Aztec (WGA) and Central Plains Water (CPW), supporting aspirations to reconnect an existing constructed wetland to a reliable freshwater source from the adjacent Papatahora Stream.

WGA **(Cameron Jasper)** installed a stilling well and automated water level sensor to enable continuous level monitoring, with CPW undertaking the first manual flow gauging to support development of a robust flow record. Te Taumutu Rūnanga representatives assisted on site during installation and gauging. The baseline data will inform whether stream diversion can occur while protecting both stream and wetland health.

Seadown Main Drain Realignment Groundwater Modelling

WGA **(William Dench and Brett Sinclair)** completed a groundwater numerical modelling investigation to support Environment Canterbury's coastal adaptation programme along the Waitarakao, Washdyke and Seadown coast. The modelling was commissioned by Environment Canterbury to address key information gaps for Stage 2 of the Seadown drainage and stopbank realignment project, which is being progressed to manage coastal erosion risks and maintain effective land drainage.

Working with Environment Canterbury's rivers and groundwater science teams, the model was developed to represent current groundwater and drain conditions and to test a range of possible future drain and stopbank alignments. The outcomes are being used by Environment Canterbury to inform consenting decisions, support the design and staging of infrastructure works, and improve understanding of groundwater interactions with Seadown Main Drain, associated wetlands and Waitarakao Lagoon.