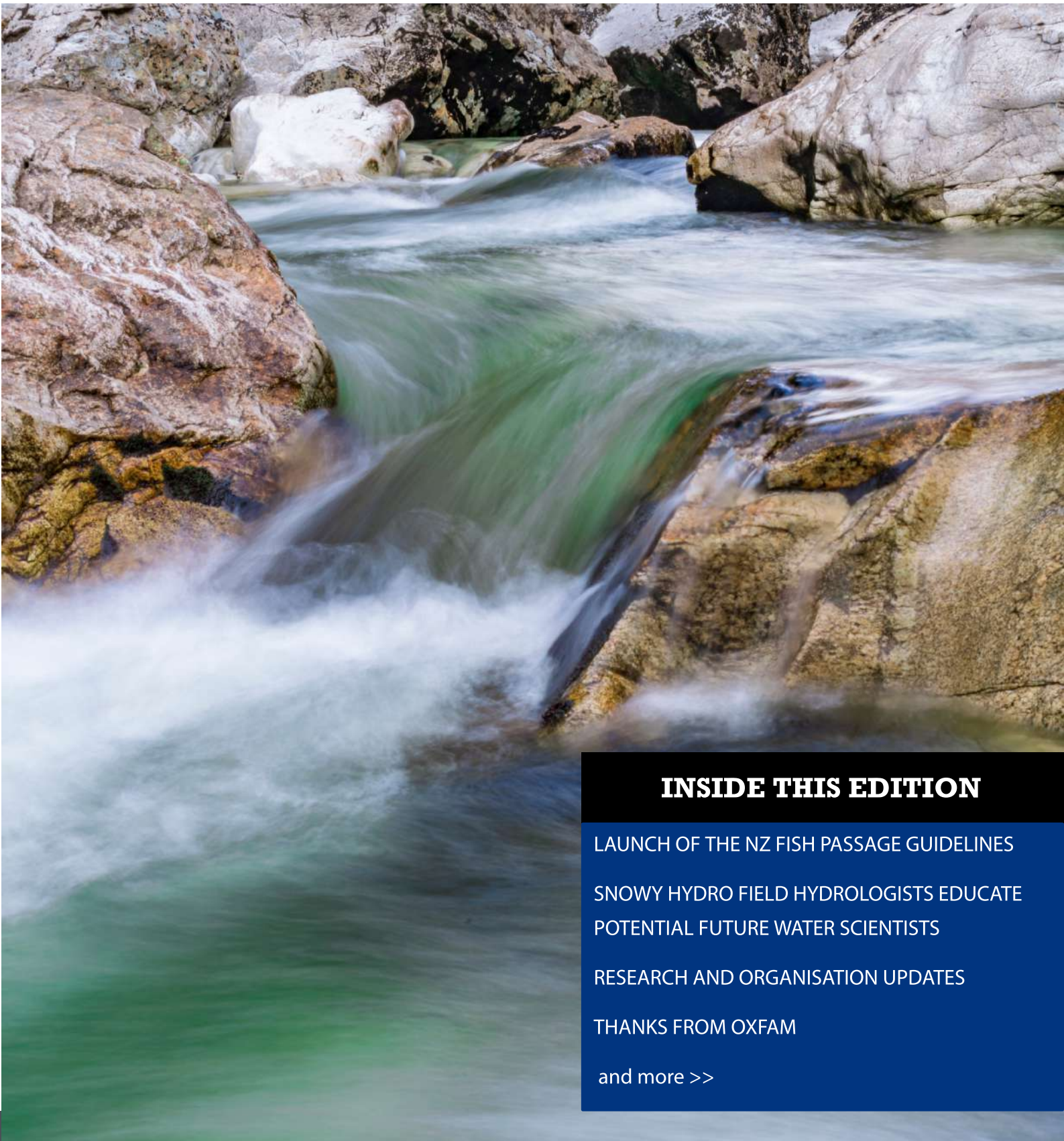
NEW ZEALAND HYDROLOGICAL SOCIETY

Current Newsletter



INSIDE THIS EDITION

Newsletter No.53 / May 2018

MESSAGE FROM THE EXECUTIVE

Mike Thompson

Welcome to this 53rd edition of Current newsletter.

Helen Kinaston has now taken on the role of producing the newsletter with support from Laura Keenan. Thanks to them both; they've done a great job pulling this one together and I am sure you will all continue to respond enthusiastically to their future requests for material.

Speaking of which, the content of this issue is typically diverse, reminding me again what an interesting bunch we are. In the next 50 or so pages you will be able to check the pulse of various projects being led out of our research institutes and consultancies as well as hear about recent training courses and what some of the Society-funded students are up to. You may also find you eyes drawn to some more eclectic topics and exploits like a 'deep uncertainty' meeting (nothing to do with the self-esteem of hydrologist you'll be pleased to know), fidget-spinner flow turbines and a mountaineering conquest in Argentina!

The folk at Tasman District Council have chipped into this issue with a fascinating (and sobering) account of ex-tropical cyclones Fehi and Gita doubling down in February. There is a wealth of knowledge and data residing with our regional and territorial authorities so thanks for sharing TDC!

And it's great to see the NZ Fish Passage Guidelines released. The guidelines are the culmination of a lot of hard work and hopefully get the use and application that they deserve. Another notable recent publication is the special edition of the Journal of Hydrology (Volume 56, December 2017) with contributions from our Australian and Korean colleagues. It is nice to see such an initiative spin out of our international relationships and particular thanks to Richard Hawke at our end for getting it over the line.

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@hydrology.org.nz

Advertising space is available; contact Helen Kinaston at the above address to find out more.

The views presented in Current do not necessarily represent policies of the Society.

Photo on the front cover: a photo taken in Fiordland by Dave Allen of NIWA.

David Leong, a long standing and active member of the Society has joined the Executive Committee. Welcome along David.

And finally from me. It is never too early to start thinking about the annual conference. We link up with colleagues and friends from the Meteorological Society this time in Christchurch and the planning committee are well underway and brimming with ideas. Look out for the 'save the date' notice on age 5.

Happy reading!

Cheers

Mike

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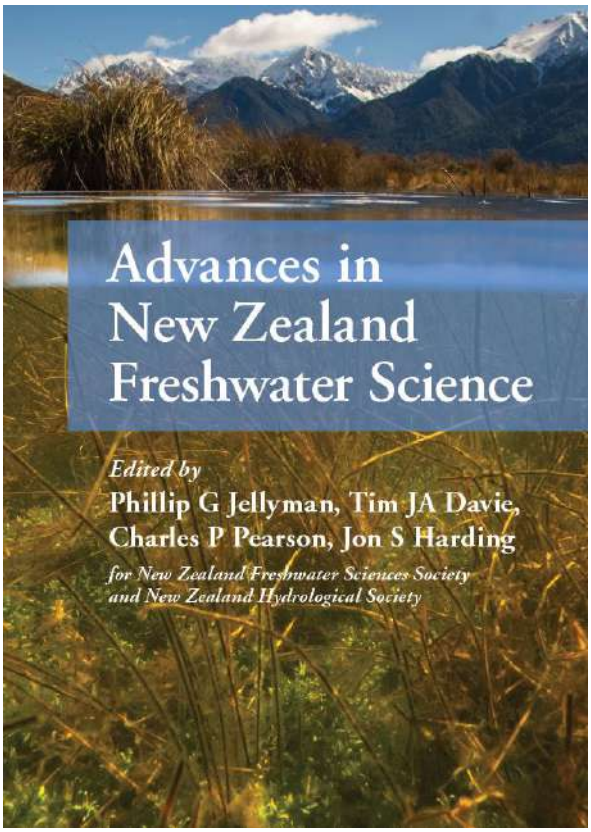
Advances In New Zealand Freshwater Science

It is not too late to get up to date! There are still copies of *Advances in New Zealand Freshwater Science* for sale.

The book costs $100 including postage and handling.

You can download an order form here and submit to **Helen Kinaston** at this email address.



SAVE THE DATE

2018 NZ Hydrological Society and NZ Meteorological Society Joint Conference

4-7 December 2018

"The Hydrological Cycle in Changing Times"

Visit the conference website HERE

Farewell Jolyon Manning

MANNING, Jolyon Christopher:
Of Alexandra, passed away peacefully on Monday 9 April 2018, in his 85th year. Dearly loved husband of Enny. Much loved father and father-in-law of Marina; Christopher and Helen; and William and Shurong, and grandfather of Nicholas, Jing, Madeleine and Hannah.

Mr Manning was a long standing member of the NZHS having joined in 1962.

Mr Manning spent more than five decades as a champion of conservation, biodiversity, and ecological protection. In 1961 he and his wife Enny created Jolendale Park, NZ's first covenanted semi-arid exotic woodland reserve on six hectares of parkland on top of Alexandra's Bridge Hill. Jolendale was permanently protected by the QEII Trust in 2004 as the sole registered "semi-arid woodland reserve" in New Zealand and a few years ago was gifted by the Mannings to the community.

Mr Manning was Chief Executive of the former Otago Council, and served in governance roles in many regional and national organisations including the NZ Forestry Council, the NZ National Parks Centennial Commission, the Otago National Parks Centennial Commission, the NZ Tourism Council, Dunedin City Council, and Otago Polytechnic. He established the monitoring of regional statistics from Northland to Southland in the early 1960s and prepared the model that was adopted by Norman Kirk's government in the early to mid-1970s.

Information provided by Neil Blair

To learn more about Jolendale Park you can visit http://jolendale.com/

NOTICES

Don't forget.....we have a Facebook page

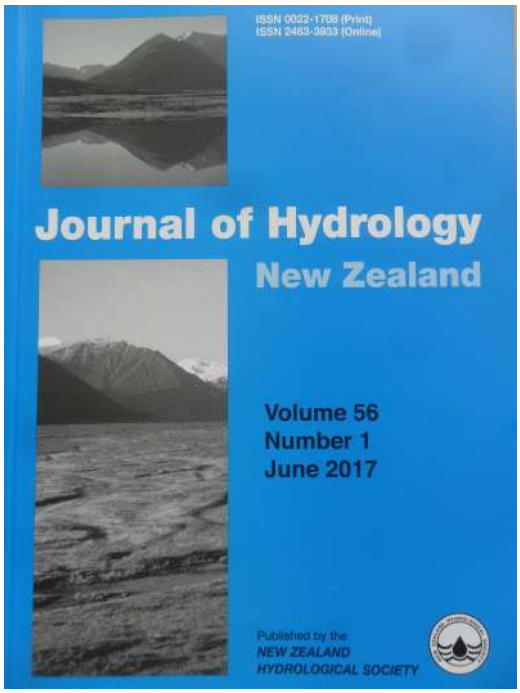
You may or may not be aware that the Society has an active Facebook page. This is a great place to reach a diverse and growing audience with information, articles and videos, links, invites to events and much much more. Take a look here if you haven't already.

Raelene Mercer is the caretaker of the page.

Keep in mind.....submitting a paper to the Journal

Papers for the Society Journal (NZ Journal of Hydrology) are always encouraged. Think about turning your conference papers in to journal articles. If not a full paper, perhaps a Technical Note. And papers need not be constrained to pure hydrology; water planning and management papers are of equal interest.

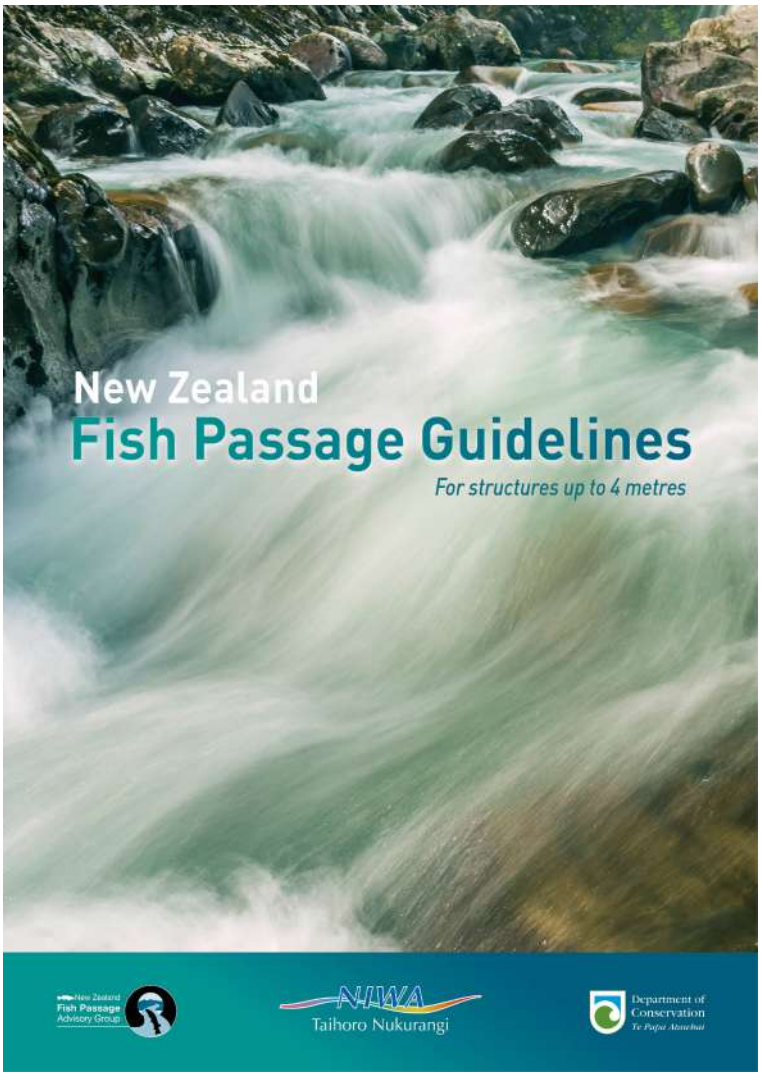
Richard Hawke is the Journal Editor.



Rakaia Gorge. Photo credit: Dave Allen, NIWA

Launch of the New Zealand Fish Passage Guidelines

AUTHOR: Paul Franklin, NIWA



The New Zealand Fish Passage Guidelines were launched by the Minister for Conservation at an event in Wellington on 18 April in the lead up to World Fish Migration Day. The guidelines were developed by NIWA and DOC in collaboration with the New Zealand Fish Passage Advisory Group. They set out minimum standards and best practice design criteria for commonly encountered instream structures, such as culverts, fords and weirs up to 4 m high.

Many of our native freshwater fish species need to move between the sea and freshwaters as part of their life cycle to access critical habitats. When these movements are blocked by instream structures, the abundance of fish declines and species can become extirpated from upstream reaches. Based on currently collated data, around 45% of existing instream structures may impede the movements of fish and other aquatic organisms, despite requirements in regional plans and the Freshwater Fisheries Regulations 1983 to provide fish passage. This problem has arisen because structures are frequently designed and installed with little or no consideration of fish passage requirements, or are not maintained so that they develop into barriers over time.

The new guidelines set out nationally-consistent minimum design standards for providing fish passage at new structures. This provides greater certainty for practitioners, and will enable more effective implementation and enforcement of existing fish passage legislation. The minimum design standards will require a significant shift in existing design practices for structures such as culverts and weirs. Rather than focusing primarily on hydraulic conveyance, it will also be necessary to accommodate the movements of aquatic organisms from the outset of the design process.

Information is also provided in the guidelines on suitable methods for remediating the many existing barriers to fish migration that exist in our waterways. Culvert perching, i.e., the development of a vertical drop at the culvert outlet, high water velocities and physical blockages (e.g., caused by tide gates) are common problems for fish passage at existing structures. Advice is provided on appropriate designs for fish ramps and baffles, which can help overcome these problems and promote improved fish passage.

Two examples: Left - what we don't want in our waterways, a perched culvert and above - what we do want - stream simulation

While enhancing fish passage is generally preferred, there are some circumstances where barriers are important for preventing the movements of invasive species that threaten critical species and habitats. The guidelines also address this unique situation, sharing lessons learned and design standards for creating built barriers for the protection of native fish species.

Around 120 people attended the launch event that was hosted by MfE and organised by the New Zealand Fish Passage Advisory Group. The audience was provided with an overview of the new guidelines, which were received well by ecologists, engineers, hydrologists and planners alike. It is hoped that the launch of these new guidelines will result in a step-change in how people approach the design and construction of instream structures across New Zealand, resulting in immediate benefits for our freshwater biodiversity. Removal or remediation of existing structures is also important for relieving pressures on our threatened native fish communities. The Fish Passage Advisory Group would like to thank all those who attended the launch event, and acknowledge the support of the Rivers Group and Tasman District Council who contributed funding to ensure that the launch event was free for all participants.

For a copy of the guidelines please visit: www.niwa.co.nz/fishpassage

For more information and resources on fish passage management please visit: www.doc.govt.nz/fishpassage

Snowy Hydro field hydrologists educate potential future water scientists!

AUTHOR: Mic Clayton, Team Leader Hydrographic Services, Snowy Hydro Limited, New South Wales, Australia

In early November 2017 a group of enthusiastic International Baccalaureate program students from Canberra Grammar visited the Snowy Mountains region, undertaking a geography project on the Thredbo River. Their study project required them to measure a variety of river characteristics (shape, water velocities, depths, widths, etc) to understand how the hydraulics of the stream changed down the catchment, from the headwaters above Thredbo down to near where it flows into Jindabyne Dam.

The group also visited Jindabyne Dam to further understand its role in the Snowy Scheme, how this century's dam upgrades are benefiting the Snowy River downstream of Jindabyne Dam and how the emergency spillway was designed to operate in an extreme event following ANCOLD reviews and implementation.

Gauging using the traveller at Thredbo River

As part of their monitoring activities they undertook an ADCP discharge measurement, with the assistance of Mic Clayton and Shane Mogg from Snowy Hydro who met them at the Thredbo River gauging station just out from Jindabyne. The group also discussed the mathematical theory of how a discharge measurement is "put together" as well as discussing why monitoring and measuring stream flows accurately is so important to Snowy Hydro, how in-stream hydraulics can influence and generate the stream morphology over time, how stream health is influenced by stream flow variations, the impact of human activities on river systems and similar catchment-related topics.

Group at Jindabyne Dam

The ADCP gauging they undertook was compared to the techniques they used upstream and also referenced to the National Hydrometric Guidelines. They were very excited to learn that their measurement was consistent with recent measurement trends and the discharge rating for the site and would become part of the gaugings database!

The students quickly grasped the variations in stream velocities and depth and its importance in accurate flow measurement. Putting the measurement in the context of Snowy Hydro's water accounting obligations also highlighted the importance of measuring flows consistently and to a standard/guideline. Other discussions highlighted how hydrometric data is used by engineers, water managers and others in a wide range of applications in the wider world, broadening their appreciation of the work undertaken by field hydrologists.

The group undertaking a variety of measurements and observations, upstream of Thredbo

An important aspect of this type of community education opportunity is the potential for engendering an interest in the profession for the "next" generations to embark upon. Enabling an exposure to the traditional methods of hydrological field measurements and the newer innovative technologies and techniques being used display hydrology as an innovative profession to be involved in.

Undertaking surface velocity measurements at the gauging station

Discovering the Real Dirt in Hydrology - NZHS Suspended Sediment Workshop

AUTHORS: Micah Dodge and Raelene Mercer, Horizons Regional Council

In March this year, hydrologists and environmental monitoring officers from around New Zealand descended on Palmerston North to "Discover the real dirt in hydrology".

Over four days, this NZHS technical workshop, addressed the challenges and successes in monitoring suspended sediment loads, the latest in best practice data collection, and analysis and quality assurance of related data. The scope of the workshop included comparisons of different data capture methods, laboratory analyses, surrogate technologies, and field methodologies.

The keynote speaker, John Gray, Principal of Gray Sedimentology, formerly National Sedimentologist with the U.S. Geological Survey's Office of Surface Water, brought 38 years of experience to the event. While there was a wealth of collective knowledge and experience present in the room, attendees newer to the game also added value by contributing their thoughts and views to the conversation.

The field component of the workshop was a highlight for the attendees, despite the weather conditions, which were not ideal, or absolutely ideal, depending on your point of view. The entire group proved that a "little" rain never stopped a hydrologist from making the most of a learning opportunity. With the aid of vehicles, waratahs, ropes, a can-do attitude, and a BBQ lunch, the group were able to get a lot of practical information and new skills under their belts. Despite a few technical faults experienced with the hardware, feedback indicates that the participants enjoyed the day and came away with a good understanding of the whole system.

Participants on the banks of the Manawatu River at Horizons Regional Council's Teachers College gauging site

Congratulations to Ethan Coulston from GWRC, who came away with the prize for the Best Young Presenter for this year's workshop. This prize was sponsored by ENVCO and will go towards getting Ethan to the next AHA conference in Australia.

During his visit to NZ, John also spent time with Horizons Regional Council and Waikato Regional Council, and has recently lent his expertise to reviewing the Suspended Sediment Monitoring NEMS document, currently under development.

Thanks to Horizon's Regional Council Catchment Data Team, in particular Micah Dodge, for the time and effort in organising an excellent event.

John Gray explaining sediment sampler use

News from WGA NZ

AUTHOR: Clare Houlbrooke

Hinds/Hekeao Managed Aquifer Recharge project – new sites testing programme

Over the past month **Bob Bower** and **Brett Sinclair** (WGA NZ), **Mark Trewartha** from Environment Canterbury, and **William Dench** from MHV Water Ltd have been supporting the Hinds Managed Aquifer Recharge Governance Group and Environment Canterbury in installing and testing up to 16 new managed aquifer recharge testing sites within the Hinds/Hekeao catchment, Canterbury. A standardised soakage system design and test programme is being used to enable comparison of recharge performance in a variety of physical settings across the catchment. The outcomes of this test programme will be used to help design a catchment-wide Groundwater Replenishment Scheme (GRS) which will be encapsulated in a Hinds/Hekeao Catchment GRS master plan and business case. This investigation programme is being undertaken in parallel with ongoing operations and monitoring for Year 2 of the existing Lagmhor MAR pilot trial and the development of a Near River Recharge (NRR) project on the South Fork of the Hinds River.

One of sixteen new Hinds managed aquifer recharge testing sites being trialled near Ashburton, Canterbury. Photo credit: Sam Anderson, MHV Water Ltd.

Australasian Integrated Water Management projects

Brett Sinclair, Principal Hydrogeologist at WGA NZ, has been working with **Russell Martin** and **Hayley Whitington** from our Adelaide office on modelling a proposed Aquifer Storage and Recovery (ASR) project in Australia. The Salisbury 3D Visual MODFLOW model focuses on two aquifers underlying an area of the coastal plains covered by the northern suburbs, horticultural and agricultural fringe of Adelaide. Numerous ASR bores and groundwater production bores have already been installed in this area. Further ASR bores are planned, and additional injection of captured and treated stormwater has the potential to result in flowing artesian pressures developing in the aquifer. To avoid any unplanned groundwater discharges from open bores in the area this groundwater modelling has been commissioned to quantify the risk and help identify opportunities for additional managed water storage within the aquifers, thereby helping improve Adelaide's water supply security.

WGA NZ is currently involved in several further feasibility investigations for managed aquifer recharge projects across New Zealand and Australia, including community outreach for sustainable water resources management, project planning and operations.

News from NIWA

COMPILED BY: **James Griffiths**

Italian Job

A presentation on the river, coastal and estuarine morphodynamic effects of the South Island earthquake series was given by Dr Graham Smart to Italian and international scientists on a Venetian canal barge in September. Presentations of the Smart-Jaeggi sediment transport formula were also given at the Technical University of Munich and the Vienna Institute for Water Management, Hydrology and Hydraulic Engineering.

Sediment tracking

In October, NIWA was involved in a Sediment Tracking Workshop in Wellington organised by Scion. Arman Haddadchi highlighted new developments in sediment tracing and how innovative techniques can be used to increase the temporal and spatial resolution of sediment source contribution data derived from the sediment tracing. The presentation was supported by our Land & Water National Science Challenge Sources and Flow Programme.

Tech-transfer vs co-innovation

MS Srinivasan presented the co-innovation approach at the 7th Asian-Australasian Conference on Precision Agriculture in Hamilton, in November. Referring to the recent MBIE programme, Primary Innovation, at Waimakariri Irrigation Scheme, the talk generated lots of interest among the attendees who acknowledged the need for knowledge transfer to encourage better practice uptake among farmers.

Deep uncertainty

Daniel Collins attended the annual meeting of the Society for Decision Making Under Deep Uncertainty at Oxford (UK) in November. As methods for accounting for "deep uncertainty" in management and policy decisions are underused in New Zealand, the visit aimed to increase exposure of associated analysis methods that can used in hydrological analysis and climate change assessment.

Flood frequency

The New Zealand flood frequency project continues to make progress as new catchment variables from GNS' QMAP project are extracted for all catchments in New Zealand. The next step is to add new variables (annual rain, depth to basement rock, hydraulic conductivity, porosity) to regression analysis that will be performed for catchments in the North and South Islands. Model choice and contouring of the error surface will be used to refine results. The final model will eventually find its way to a web-address hosted by NIWA.

Fiji water statistics

Work has commenced on a method to allow the Fiji Met Service to use QGIS with CLIDESC. The system will facilitate data propriety, allow better water accounting, and provide the capability for locally-controlled update of future records.

Our Land and Water National Science Challenge

As a part of Our Land and Water National Science Challenge, NIWA hosted a two-day workshop in Christchurch in November. The workshop was attended by researchers from AgResearch, NIWA, ESR, Landcare Research, GNS Science, Massey University, Plant and Food Research, Australian National University and Lincoln University. The workshop explored the use of the 'I2S' framework (Integration and Implementation Sciences) in enhancing the impact of science projects. Discussions focussed on enhancing the links between science programmes within the challenge and future plans for the program.

Groundwater ecosystems

Envirolink funding will be used to develop a comprehensive report on existing national and international groundwater ecosystem information. The report will address what is known about groundwater ecosystems and the services they provide, threats to their functioning, and how these services sustain human values associated with groundwater. The report is intended primarily to develop a national understanding of New Zealand groundwater ecosystems, and inform policy development at both regional and national levels.

New staff and departures

In the last edition it was noted that Dr Channa Rajanayaka had left Aqualinc (Hamilton) but we forgot to mention that he had joined the Hydrological Processes Group at NIWA Christchurch! Channa's expertise is in groundwater modelling, and he is already having a beneficial impact on the groundwater modelling team at NIWA Christchurch which recently lost Mabrouk Abaza back to Canada. Christchurch hydrologists have also lost Jan Diettrich to his homeland, as he takes a one-year career break.

HydroSoc 2018

NIWA will help coordinate the joint Hydrological and Meteorological Conference in Christchurch in December 2018 with MS Srinivasan acting as Chair of the organising committee. MS will be assisted by a team from ESR, GNS, Waterways Centre, Environment Canterbury, Victoria University, and Met Service.

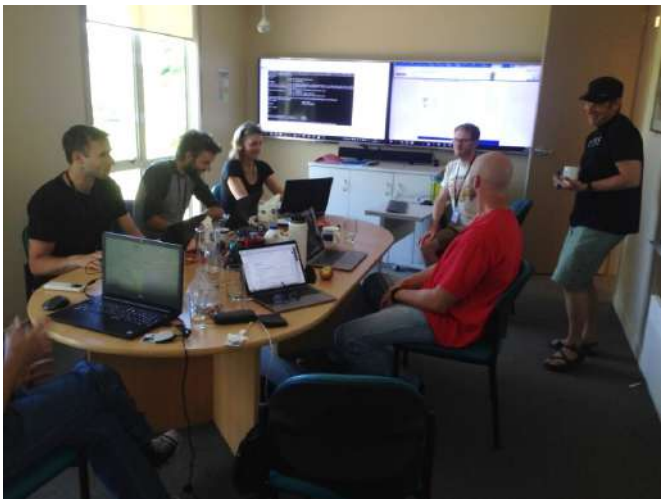
UPDATE FROM GNS

COMPILED BY: Conny Tschritter

Staffing

Jeremy White joined our groundwater modelling team as a Senior Groundwater Modeller at the end of last year. Jeremy was previously employed by USGS specialising in numerical modelling of environmental systems, parameter estimation and uncertainty quantification in highly-parameterized settings, and code development. He is involved in the development of PEST - Model-Independent Parameter Estimation & Uncertainty Analysis, pyEMU - a python framework for Environmental Modelling Uncertainty analyses, and FloPy - a Python package for creating, running, and post-processing MODFLOW-based models.

Guest scientists



USGS scientists Daniel Feinstein and Mike Fienen visited and worked with our groundwater modelling team to develop groundwater meta-models (see action shot!). The models developed are being used within an economics model optimisation which seeks to meet environmental criteria while optimising economic outputs. It is the first direct integration of landuse, surface- and ground-water quality, and economics models that we are aware of, allowing for more robust economic-environmental decision making.

Satellite data for automated mapping of the dynamics of wetlands and flood plains

Rogier Westerhoff has been working on the assessment of seasonal vegetation and inundation dynamics of wetlands and historical flood events in New Zealand, using advanced satellite data from the Sentinel missions and rapid cloud-based classification techniques. His methods were based on machine-learning classification and thresholding techniques of satellite data from the Sentinel-1 (radar) and Sentinel-2

(multi-spectral) missions, combined with older Landsat data. Rogier applied these methods to measure the dynamics of vegetation and water extents of wetlands and flood plains (i.e., Lake Whangape and Kopuatai Peat Dome in the Waikato region), and to map the dynamics of flood plains through recent major flood events (i.e., Edgecumbe floods of April 2017, Otago floods of July 2017, Figure 1).

Data were processed in Google Earth Engine, a cloud computing facility with a multi-petabyte archive of satellite, climate and forecasting data. The advantage of using Google Earth Engine is that it takes away the huge burden of downloading, storing and processing Big Data.

Satellite image of the Waihola-Waiori wetland and Taieri floodplains during the July 2017 floods in Otago (image: Sentinel-1 dual polarised, 22 July 2017, 7.45pm). Surface water is represented by dark colours in the satellite imagery. Visualisation is through the coding environment of Google Earth Engine.

Westerhoff, R.S.; Tschritter, C. 2017 Satellite observation of wetland dynamics and recent flood events in New Zealand using Google cloud computing services. p. 223-224 In: New Zealand Hydrological Society Annual Conference, 28 November - 1 December 2017, Napier Conference Centre. Wellington, N.Z.: New Zealand Hydrological Society.

Machine learning for NZ groundwater baseline trends

As part of the NGMP programme, **Magali Moreau** and **Chris Daughney** have defined baseline trends for NZ groundwaters using a machine-learning-augmented dataset. Baselines were derived at 234 sites (100 sites from the NGMP network) for 13 parameters for the 2005-2015 period and could be used as benchmarks when assessing temporal trends in groundwater quality. This information is essential to inform us how rapidly groundwater chemistry changes in the absence of human influence and can be used to gauge policy effectiveness. This work builds on a 2006 study based solely on NGMP data. The aggregated NGMP and SOE dataset was extended to include regional state of the environment monitoring data using machine-learning techniques. In addition, multivariate statistics were used to identify impacted sites, which were removed prior to the baseline analysis. The technique developed here is relevant and transferable to any other long-term environmental monitoring network.

Emerging contaminants

Magali Moreau is leading the first groundwater baseline survey for emerging contaminants in New Zealand, through a collaborative research project between GNS Science, Waikato Regional Council, the British Geological Survey (BGS) and the UK National Laboratory Services (NLS). BGS and NLS have conducted many emerging contaminants surveys worldwide. BGS is currently providing input to the European Union in regard to setting priority list substances for drinking-water regulations. The NLS has provided more than 10 years of analytical services, developing a unique database for emerging contaminants. To prepare for the NZ survey, Magali received a 2-week training at BGS Wallingford (UK) in September 2017, which covered monitoring design, sampling, laboratory manipulation and interpretation. Emerging contaminant sampling in the Waikato region started in April. The collection of samples involves chemical fixing of contaminants on an SPE cartridge (Figure 2) following a new technique, developed by BGS and NLS and published in 2017. This technique suits samples from both surface- and ground-water. The Waikato samples will be analysed for over 700 compounds classed as emerging contaminants.

Figure 2. Left: Sampling with WRC in the Taupo area. Top: Micro-extraction of emerging contaminants from groundwater samples into pre-conditioned cartridges (encased within a small syringe). Groundwater samples are collected, unfiltered and unpreserved in a 1L glass container. Care should be taken to limit potential contamination of the sample upon collection. Bottom: A challenging site to collect 1L samples! :) No images of Magali collecting the samples because she got really drenched on that one. (The site isn't actually artesian, but samples are collected from valves.)

3D printing of geological models

GNS has been developing three-dimensional geological models for hydrogeological applications for more than 15 years. Over the last six months, we have been trialling the 3D printing of these geological models (Figure 3). The purpose of these trials includes to identify what processing steps have to be done before a model is ready for printing, and what applications there are for 3D printed geological models. For example, outreach and education are the most obvious ones. However, there are many other potential applications for these models. For example, a recent presentation of a model that was also attended by blind people highlighted how much they appreciated being able to discover topographic and geological features with their hands.

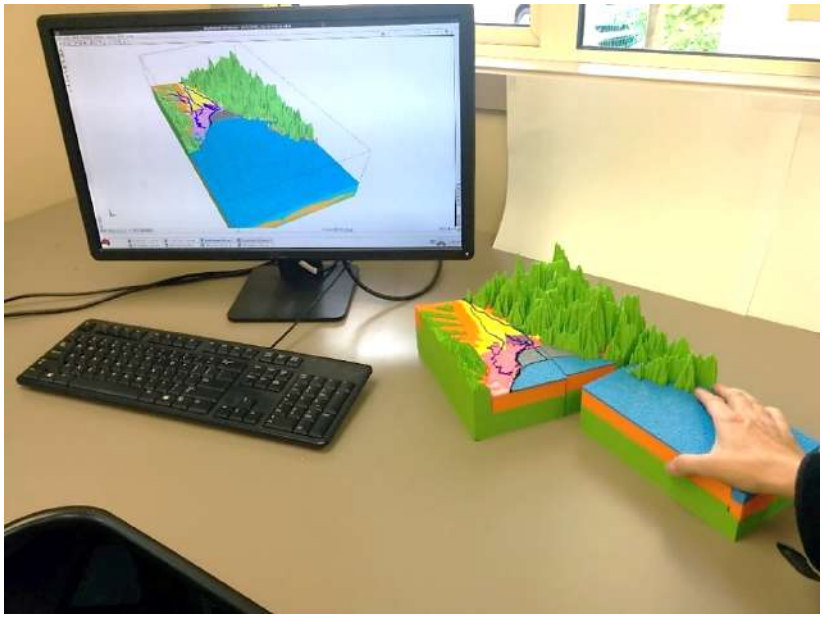


Figure 3. 3D geological models of the Wairau Plains, Marlborough. The left-hand side of the image shows the EarthVision 3D computer model, developed by Paul White and Conny Tschritter. The right-hand side of the image shows the 3D print of this model.

Alternative flow meters – or the one where an entire class of school kids got involved in hydrological field work

The MBIE-funded 'kaitiaki flows' Vision Mātauranga project between Ngāti Rangiwewehi and GNS aims to assist with placing iwi (as kaitiaki) at the centre of water allocation decisions with regard to spring-fed streams. In this case, Ngāti Rangiwewehi are kaitiaki of the Awahou Springs, located near Rotorua. As part of the project, in April GNS groundwater staff (**Paul White, Heather Martindale and Zara Rawlinson**) and Lee-Anne Bidwell (Ngāti Rangiwewehi), with assistance from Wayne McGrath (NIWA) and Russell West, taught around 20 school kids from a Rotorua Maori-language immersion school about the Awahou Springs. During this time, they learnt the history and culture of the site and investigated the hydrology of the area with class exercises that involved measuring flow. Flow meters based on 'fidget spinner turbines' (Figure 4) were used in these exercises because these were thought to be a kid-friendly activity in flow measurement. They were developed by GNS; Paul did the design using EarthVision software and **Ryan Davidson** did the 3D printing of around 20 of these. Paul calibrated the devices using NIWA's rating tank (thanks to Grant Thyne). The fidget spinner turbines were quite a hit with the kids!

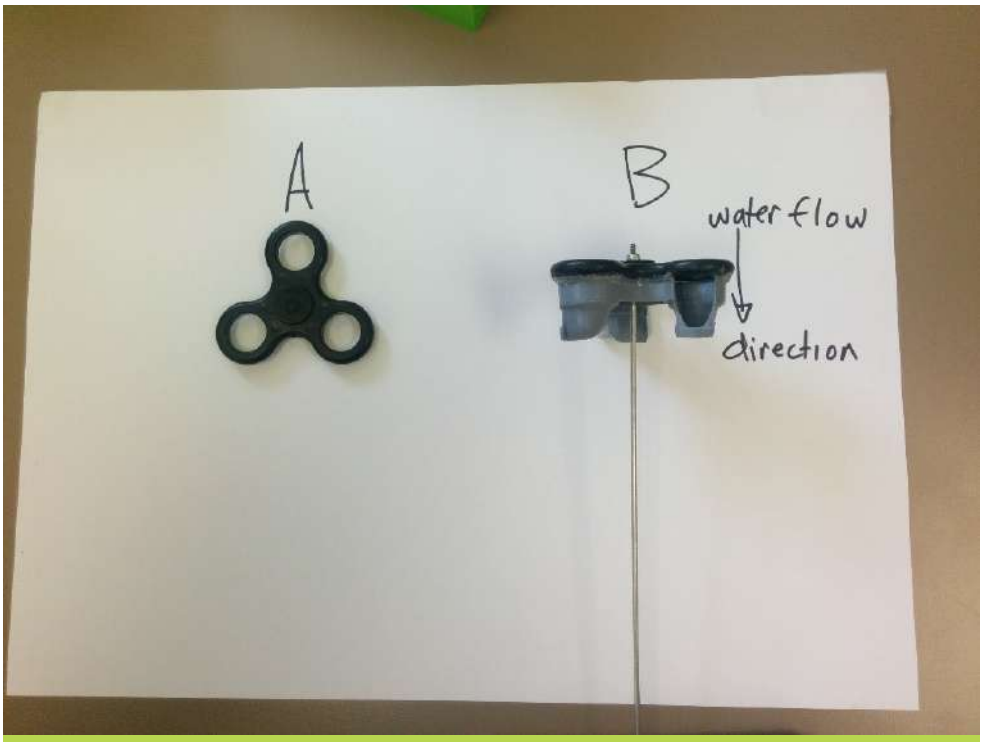


Figure 4. A: the fidget spinner; and B: the fidget spinner turbine - Ryan 3D printed the turbine, i.e., the grey attachment to the fidget spinner, that were together mounted on a stainless-steel rod.

Groundwater modelling

The modelling team (**Brioch Hemmings, Cath Moore, Jeremy White, Matt Knowling** and **Mike Toews**) continues to contribute to the ongoing development and stress-testing of both industry standard and new generation groundwater modelling, uncertainty analysis and optimisation tools (e.g., MODFLOW, MT3D, PEST, FloPy, HydroGeosphere, PyEmu, PEST++). This software is being deployed in both our research activities (Smart Aquifer Management, SAM) and our commercial work. Commercial work has included regional modelling to assess stream depletion effects and nutrient transport pathways (ECan, HBRC, WRC and GWRC). This software is also being deployed in our collaborations with other CRIs; e.g., in the National Hydrological Project with NIWA and modelling and upscaling heterogeneous aquifer properties (using T-Progs and ALLUVSIM software) to better understand the upscaling of transport processes with ESR. The SAM programme (undertaken in collaboration with NIWA, VUW, ESR, LandWaterPeople, Market Economics, Earth in Mind, Watermark Numerical Computing, Waikato University, ES, WRC, and GWRC) is defining modelling metrics that can be used for decision support, and exploring the ability and trade-offs of simple/complex models to meet these metrics in typical NZ environmental contexts (decision crash testing of models). This work includes the development of new modelling methods (e.g., that can be integrated well with ecological and economic models), as well as assessing the performance of existing models, combining to provide a modelling toolbox, which includes components for risk assessment and uncertainty analysis to support decision-making. A guideline document on use of models for common water management questions, and the extent to which different data

Aqualinc

COMPILED BY: **Tim Kerr**

Soil moisture monitoring

Over the summer the Field Services business of Aqualinc took on eight seasonal staff to have a total of 15 people monitoring soil moisture full time. 1440 sites were regularly monitored using neutron probes. **Phil Neill**, the Field Services manager, considers the summer's regular sporadic rainfall enabled soil moisture levels to be well managed this year.

Phil Neill checking the soil moisture at one of the 1440 sites that Aqualinc monitor around the country.

Sustainable Nutrient Management

Olivia Cranney is currently obtaining her advanced accreditation for Sustainable Nutrient Management in New Zealand Agriculture. With **Nicole Matheson** and **Sarah Hayman**, Aqualinc now have three consultants accredited to prepare Overseer nutrient budgets for farms.

Lysimeter installation.
The black circles are the lysimeters, the concrete pipe is the access to drainage collectors.

New nutrient-monitoring lysimeter installations

Ross Hector and **Dan Farrow** recently installed 12 new lysimeters on a Canterbury dairy farm for ECan, in collaboration with NIWA, for investigating the passage of water and nutrients through the soil column. Each lysimeter drains to a separate container housed in the nearby concrete pit. Multiple lysimeters enable spatial variability of drainage to be assessed.

Irrigation mapping

Following on from irrigated area mapping that we carried out for Environment Canterbury in 2015 and 2016, **Andrew Dark**, with the assistance of **Birendra K.C.** and **Ayaka Kashima** have created a national spatial dataset of irrigated area for MfE. This was made available on MfE's data service in late 2017. Features in the spatial dataset are categorised by irrigator type (pivot, k-line, drip, etc.). Previous estimates of New Zealand's total irrigated area have relied on interpretation of consents or agricultural census data. The new dataset has a number of potential uses, including for water resource studies, and for developing land-surface inputs to groundwater models.

Irrigated area mapping example.

Aqualinc reaching new heights

Hydrogeologist **Mark Flintoft** successfully ascended Mt Aconcagua in Argentina over summer. Aconcagua, at 6961 m, is the highest point in the Southern Hemisphere. In his usual understated manner Mark said the "the view was great, but it was a bit cold".

Aconcagua.

Flintoft "knocked the bastard off".

Ruataniwha without a lake

Ian McIndoe has been working with existing surface water irrigators to work out how to maintain water supply reliability under the pending increase in minimum flows in the Tukituki and Waipawa Rivers, in the Hawkes Bay region.

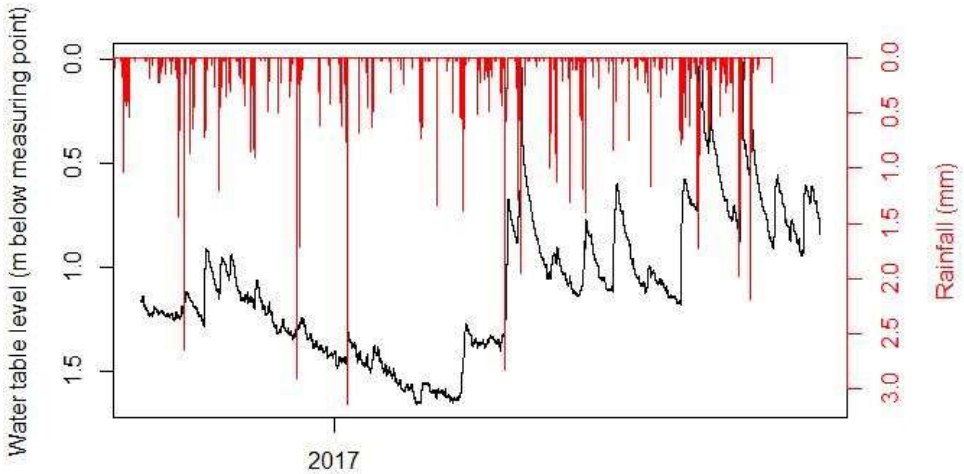
Innovation Award finalist

Aqualinc was one of the three finalists in the Irrigation New Zealand Innovation Award for our GeoRural data management system. Aqualinc's GeoRural system, managed by **Ayaka Kashima**, provides a spatial data management system set up specifically for Irrigation Schemes.

Example screenshots from the GeoRural system of spatial data management for irrigation schemes.

Christchurch shallow groundwater monitoring

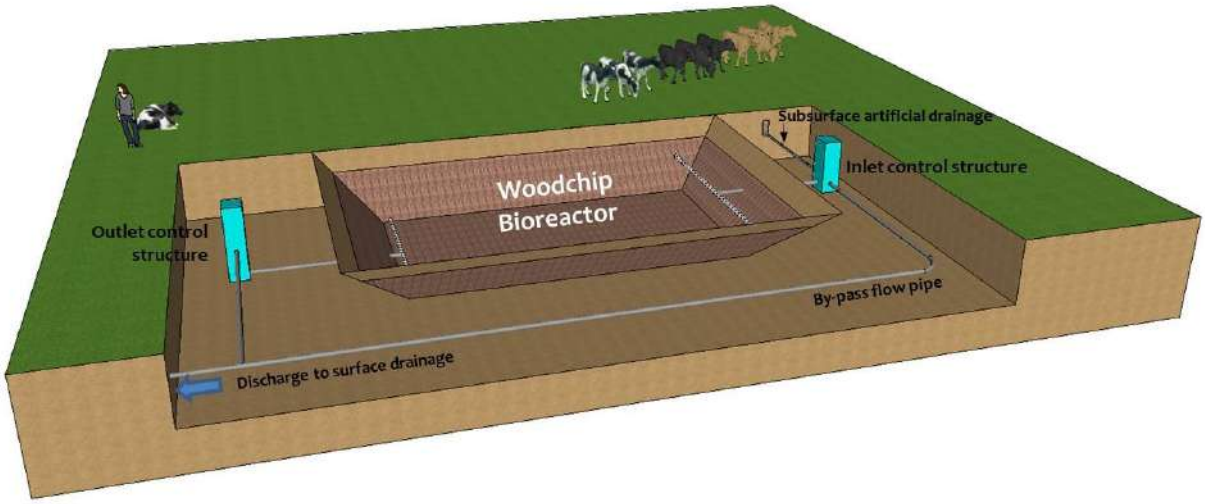
Aqualinc has carried out an initial assessment of high resolution (10 minute) groundwater level data being collected from 250 shallow bores throughout Christchurch city. The unprecedented spatial and temporal data has highlighted the enormous variability in how shallow groundwater interacts with tides, evapotranspiration, streams, deeper aquifers, infrastructure, land cover and rainfall. **Helen Rutter** hosted a workshop involving EQC, Tonkin and Taylor, GNS, NIWA, Christchurch City Council and Environment Canterbury to discuss the value of the data and look at options for continued monitoring.



Example Christchurch shallow groundwater variability and rainfall.

Bio-reactor

Greg Barkle is collaborating with Lincoln Agritech to test a denitrifying bioreactor in the Hauraki Plains. The main objective of this research is to assess the applicability and performance of denitrifying bioreactor technology in reducing nitrate loads from subsurface drains in New Zealand pastoral lands.



Bioreactor for denitrification of pastoral drainage water.

The bioreactor built has a volume of approximately 60 m^3 filled with locally-sourced untreated pine (Pinus radiata) woodchips. We route the drainage water from a lateral subsurface drain into the bioreactor. Inlet and outlet waters are sampled for nitrogen and carbon, to assess the effectiveness of the bioreactor in attenuating nitrate, and for a range of other analytes to investigate the possible occurrence of negative side effects.

Monitoring data from the first season of the bioreactor's operation demonstrates the bioreactor was very effective at removing the nitrate that entered the bioreactor with over 99% removal efficiency. The team is keen to see how the technology will perform over this upcoming winter with higher flow rates.

DHI Water and Environment

COMPILED BY: Rose Jowsey

Some of the key projects that our team are currently involved in include:

The **Okura Weiti Sediment Transport Modelling project,** which is currently underway with John Oldman from our Marine team working with Auckland Council. The project is funded by the council Healthy Waters team, who is also collaborating with the Department of Conservation in obtaining scientific research permits, Morphum with compiling catchment modelling information, and Vision Environment for marine water quality instrumentation.

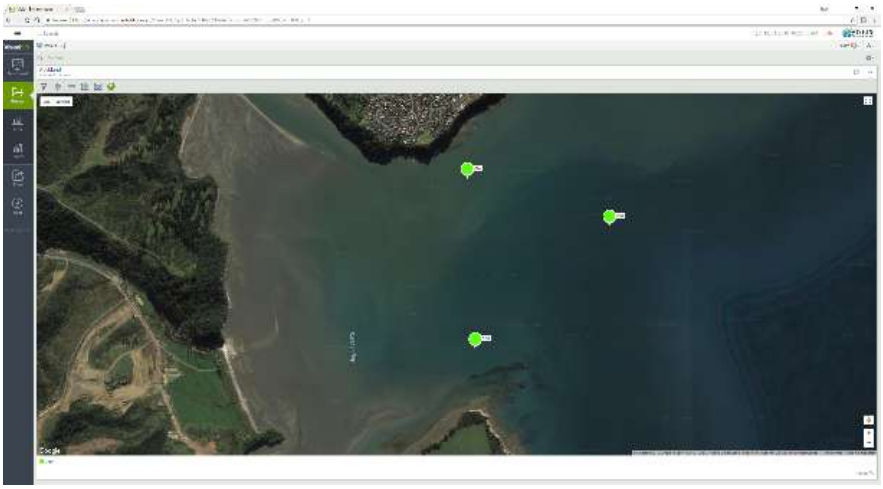
The key objective of the study is to examine the connectivity between catchment land use and potential impacts on the marine environment. The project will enable Auckland Council to better manage future development within the catchments in and around the Long Bay-Okura Marine Reserve to minimise and/or mitigate potential impacts within the marine receiving environment - including the Long Bay-Okura Marine Reserve.

The work involves collaboration between DHI Water and Environment and Morphum to integrate outputs from catchment-based models (Morphum) and the marine-based models (DHI). One of the key components of the work is the collection of real-time water quality, wave and hydrodynamic data within Karepiro Bay and the Long Bay-Okura Marine Reserve. Permission is currently being obtained from DOC to deploy monitoring equipment in the marine reserve.

Braveheart - based out of Gulf Harbour Marina

Market buoy

Fully coupled wave, hydrodynamic and sediment transport models are being set up and will be calibrated against data being collected throughout April to June, as well as against historic data. In August to October models will be run to examine possible future land use scenarios and determine their potential effects on the marine receiving environment.



Sites of the multi-sensor instruments recording temperature, currents, salinity, turbidity, oxygen and pH levels

The **Heathcote River Flood Management Strategy Project** involves modelling a range of flood management strategies for the Heathcote River catchment, including dredging and storage. DHI has been working with Christchurch City Council and Jacobs to see this project to completion. DHI provided useful information to Christchurch City Council to allow them to make informed decisions on the direction of the flood management in the catchment. Having Christchurch City Council and Jacobs as close neighbours to our office allowed for good communication, aiding the success of this project.

Heathcote flood, March 2014. Photo courtesy of CCC.

News from Lincoln Agritech Ltd

COMPILED BY: Juliet Clague

Lincoln Agritech staff have used the dry summer conditions to prepare our field sites for the winter drainage season. In particular, our denitrifying bioreactor in the Hauraki plains has had some modifications done (see photo) to prevent blockages and back-flow of drainage water experienced during a couple of last year's storms.

Tasman McKelvey operates the skid steer loader at the denitrifying bioreactor site

Tasman McKelvey can be seen in the photo operating our skid steer loader, but unfortunately he left us at the beginning of May to join PDP in Auckland. While we are sad to see him go, we wish him all the best in his new role.

Congratulations to our Dresden-based colleague **Thomas Wöhling**, who recently won an award at the German Hydrological Society conference. His poster on the Wairau River-groundwater interaction was the one best matching the conference theme 'Measure – Model –Manage'. Once again, Thomas has also won the 2017 'Best Reviewer' award for the ASCE Journal of Irrigation and Drainage Engineering.

The International Interdisciplinary Conference on Land Use and Water Quality (LuWQ) has announced dates for 2019. The conference, aimed at scientists, land and water managers and policy makers will be held in Aarhus, Denmark on the 3rd to 6th June 2019, with abstracts due in by 15th October 2018. Visit www.LuWQ2019.dk, or contact Roland Stenger (Roland.Stenger@lincolnagritech.co.nz) for more information.

Peer-reviewed publications from the last year:

Stenger, R., Clague, J.C., Morgenstern, U., Clough, T.J. (2018) Vertical stratification of redox conditions, denitrification and recharge in shallow groundwater on a volcanic hillslope containing relict organic matter. Science of the Total Environment (in press).

Wilson, S.R., Close, M.E., Abraham, P. (2018) Applying linear discriminant analysis to predict groundwater redox conditions conducive to denitrification. Journal of Hydrology 556: 611-624.

Wöhling, Th., Gosses, M.J., Wilson, S.R., Davidson, P. (2017) Quantifying river-groundwater interactions of New Zealand's gravel-bed rivers: The Wairau Plain. Groundwater doi:10.1111/g.wat.12625.

Woodward, S.J.R., Wöhling, Th., Rode, M., Stenger, R. (2017) Predicting nitrate discharge dynamics in mesoscale catchments using the lumped StreamGEM model and Bayesian parameter inference. Journal of Hydrology 552: 684-703.

News from Beca

COMPILED BY: **Elliot Tuck**

Both the Water Resources and Groundwater teams have had a busy 2017 and are looking forward to the same again in 2018. To keep up with demand the water resources team have employed two new starters. **Mark Megaughin** started with Beca in April last year as Associate Hydrologist. He is continuing to support ECan by providing hydrological input to their water resource management workload. **Katie Chalk** has joined us from the UK as a Water Resources Engineer. She has a background in flood risk and modelling, and is excited to apply her skills to New Zealand rivers. Another recent starter is **Anastasiya Verbytska** who also joins us as a Water Resources Engineer. She has recently completed a Masters in Engineering at Canterbury University. Before this she worked at a consultancy in South Africa mainly focused on water resource modelling for large hydro power generation projects.

Our new recruits have freed up time for our existing Principal Hydrologist **Mike Law** to take on the role as Water Resource leader in Beca's Technical Discipline Group. Mike's new role includes responsibility for ensuring the quality of our water resource advice across the business.

The Groundwater team has also experienced exciting growth in the last year with three new additions. **Breda Savoldelli** has joined us from Jacobs NZ Ltd as a Senior Hydrogeologist. Her work has included hydrogeological modelling of local and regional scale environments on projects including construction dewatering, stream depletion, water supply, stormwater and wastewater disposal, and catchment modelling. **Stephen Johnston** has also joined the team as a Hydrogeologist with a background in geological and geophysical interpretation of sedimentary environments and geophysical processing. Steve is happy to be returning home to New Zealand after having worked in Australia at DownUnder GeoSolutions and Geoscience Australia for the last decade. He is bringing with him a wealth of geophysical knowledge which will enrich how the team approaches its work. And finally, the most exciting new addition comes from Senior Hydrogeologist **Alexis Thomas** who had a healthy baby boy named Ben, born in July (career trajectory still to be decided).

Some of the following projects have kept the team busy.

Cameron Oliver and **Mike** have been supporting our bridge designers with a number of projects in Fiji. Completing hydrological and flood assessments for a number of ungauged catchments in a relatively data-poor region has posed its challenges. These bridges provide a crucial lifeline to remote villages, so providing all weather access is a major improvement.

The Nasau Crossing which is typical of others in the region.

Fonterra are currently re-consenting one of their processing plants in Taranaki. **Elliot Tuck** and **Cameron** have been providing technical surface water input to the project. The project has involved the creation of a water balance model accounting for the effect of abstraction on the reach of river between the abstraction and discharge locations and also the effects of temperature in the stream. The model has been possible thanks to the extensive monitoring undertaken by Fonterra. Photo shows the discharge point.

Mark, **Cameron** and **Mike** are updating and enhancing the Hakataramea catchment water balance model to support ECan's understanding of flow regimes, and implications of options to manage abstraction in the catchment. The same team are also providing ECan with similar support for the Ahuriri catchment. Mark is also working with ECan on Canterbury Water Management Strategy infrastructure projects, and is assisting with the Waimakariri Water Zone sub-regional planning process.

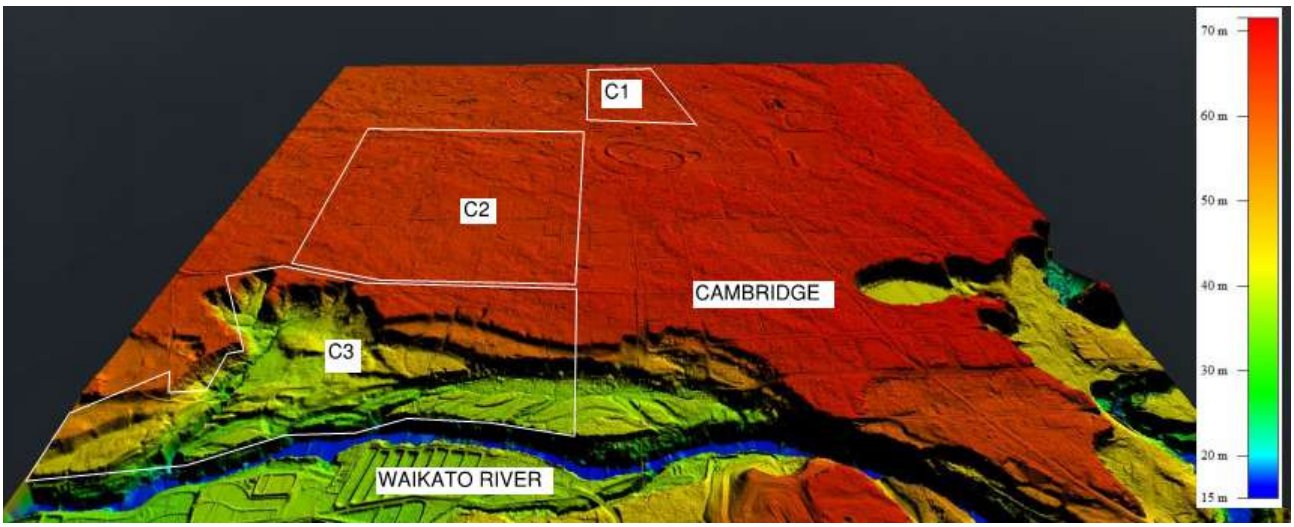
The Groundwater team's **Mike Thorley** has been assisting a number of clients across New Zealand assess the wellhead security of their water supply wells and to understand improvement options and costs.

Mike has led recent site inspections across Christchurch and provided options for remediating non-protected wellheads, such as fixing below ground wellheads or raising above ground to improve wellhead protection and compliance with Drinking Water Standards New Zealand. Possible future requirements are also being considered in light of the recommendations by the Havelock North Drinking Water Inquiry report, the recommendations of which the government is still to accept.

Another project the team has had the opportunity to contribute to is the identification of stormwater management issues for the Cambridge C1 and C2/C3 residential growth areas in the Waipa District.

The growth areas are currently mostly undeveloped pastoral land and the proposed change to residential development will create large new areas of impervious surface resulting in the need to manage and control stormwater runoff in an appropriate manner.

Dora identified the hydrogeological conditions and assessed that the underlying geology indicates soakage is a suitable stormwater disposal method in C1 and C2, but that the presence of existing steep topography in C3 means slope instability issues may be exacerbated, whilst the presence of an iron pan in other areas might drive design towards deeper solutions. When the multi-disciplinary analysis was complete, Beca was able to provide the council with a list of recommendations for managing the stormwater effects that will come with urban development in this area.



Other projects of interest include flood modelling of the Owhiro Catchment on the Taieri Plains for Otago Regional Council, flood risk modelling and drainage design for the upgrade of 67 km of rail line south of Brisbane, ongoing support of Land Drainage Recovery Project in Christchurch, construction of the Central Interceptor in Auckland, and the Akaroa wastewater deep bore injection scheme.

Land and Water Science

LAND & WATER SCIENCE

COMPILED BY: **Abigail Lovett**

Land and Water Science is a recently established environmental science consultancy based in Invercargill. Our team consists of **Dr. Clint Rissmann, Abigail Lovett, Dr. Lisa Pearson, Dr. Monique Beyer, Matt Couldrey,** and **Jess Lindsay**. We have been busy over the past months working on a range of research and consultancy projects, many of which are associated with application of the physiographic science approach. Primarily, this includes the Our Land and Water National Science Challenge Physiographic Environments of New Zealand (PENZ) research programme and collaborative project with the Department of Conservation/Fonterra 'Living Water partnership' in the Waituna Catchment, Southland. Over the next six months we are particularly looking forward to collaborating with numerous industry and local stakeholders on the Ministry for Primary Industries, Sustainable Farming Fund Project (2018 – 2021) which resumes in July. Through this project, we aim to work with farmers, industry groups, and community groups to establish a spatial platform to allow landowners to access mapping layers developed through the physiographic science approach. Ultimately, this will allow industry groups and landowners to better understand the landscape controls on water quality, and to have the required information to implement management procedures to allow for the maintenance and improvement of water quality.

Science update - The physiographic science approach

Contact: clint@landwatersci.net

The fundamental background to the physiographic approach is that water quality outcomes vary spatially across the landscape, even when there are similar land use pressures. These differences are often the result of natural spatial variation in the landscape, which alters the composition of the water through coupled physical, chemical, and biological processes. The physiographic approach is an integrated or 'systems view', predicated upon the spatial coupling between landscape attributes and the key processes governing water quality outcomes in surface and shallow groundwater. For example, the relationship between soil drainage class (attribute) and redox (process) can be used to predict soil denitrification potential. Unlike other mapping and classification approaches, the physiographic approach incorporates water quality, hydrochemical and/or hydrological response signals into a spatial format to identify, select, combine and classify those landscape gradients that drive variation in water quality outcomes. In addition, it is important to note the key difference between the high-resolution mapping undertaken through physiographic science, which is in contrast to the lower resolution, 'physiographic zones' that have been implemented by Environment Southland for a policy framework.

Physiographic science involves characterisation of process-attribute classes for hydrology and (soil and aquifer) redox, which are defined as Physiographic Units (PGU). Each PGU responds in a similar fashion at the process level to broadly equivalent land use pressures. Classification of the catchment into PGUs can be used to demonstrate that: (i) physiographic mapping enables estimation of the steady-state water composition of surface water and shallow unconfined groundwater with a high degree of confidence, and (ii) process-attribute gradients and resultant PGUs are a powerful tool for informing and optimising efforts to improve water quality. These outcomes enable efforts to be matched to the process level controls over water quality at the land parcel scale.

Physiographic science results in an increased understanding of the landscape processes, which then allows for implementation of management practices within the local and catchment scale. Examples of 'on the ground' management practices that can be implemented and which are informed by physiographic science include: land use management practices (e.g., changes to nutrient and stock rates and inputs), implementation of physical mitigation measures (e.g., riparian planting of waterways; peak runoff structures to reduce sediment during high flow / rainfall events), optimisation of the timing of fertiliser and Farm Dairy Effluent irrigation, and provision of spatial context to existing farm extension programmes.

Land and Water Science are currently working with stakeholders on several projects to apply the physiographic approach at the farm, catchment, regional, and national scales across New Zealand. Several of these projects are described below.

Project updates Contact: lisa@landwatersci.net

Living Water - Waituna Catchment

Over the past year we have been collaborating with Living Water (DOC/Fonterra Partnership) and local landowners to undertake high resolution physiographic mapping of the Waituna Catchment, Southland. The key aim of the project was to support water quality and biodiversity investment decisions for the catchment, and to assist the partnership in achieving their aim of "finding solutions to enable farming, freshwater, and healthy ecosystems to thrive side-by-side". To achieve this, we created high resolution physiographic science process-attribute layers for the catchment. The hydrological and redox process-attribute layers were identified to be the key controls over water quality outcomes in the Waituna Catchment. One of the key outputs of the project was provision of ESRI-supported story maps including a story map on Background and Technical Information and Waituna Catchment Physiographic Units and Inherent Risk to water quality.

Additional information on application of the physiographic approach to the Waituna Catchment can be found in a recently published paper (Rissmann et al., 2018), which was presented at the Massey University, Fertilizer and Lime Research Centre Workshop.

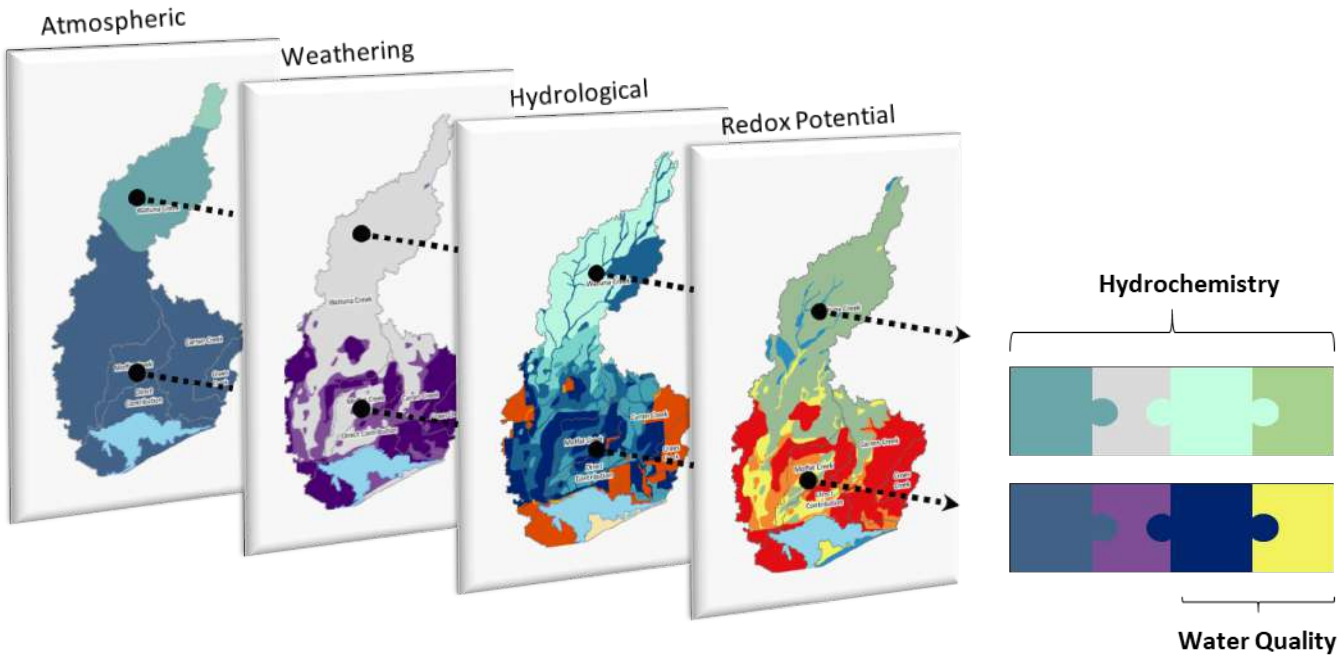


Figure 1: Example of the physiographic mapping undertaken for the Waituna Catchment, Southland.

Rissmann, C., Pearson, L., Lindsay, J., Marapara, T., Badenhop, A., Couldrey, M., and Martin, A. 2018. Integrated landscape mapping of water quality controls for farm planning - applying a high resolution physiographic approach to the Waituna Catchment, Southland. In: Farm environmental planning - Science, policy and practice. (Eds. L. D. Currie and C.L. Christensen) http://flrc.massey.ac.nz/workshops/18/Manuscripts/Paper_Rissmann_2018.pdf. Occasional Report No. 31. Fertilizer and Lime Research Centre, Massey University, Palmerston North, New Zealand. 19 pages.

Our Land and Water National Science Challenge - Physiographic Environments of New Zealand [PENZ] Research programme

Contact: abi@landwatersci.net

A key requirement of the PENZ programme has been to obtain co-funding from regional authorities throughout New Zealand, to facilitate application of the physiographic approach in as many regions as possible. It has been great to receive financial support from Northland Regional Council, Auckland Council, Bay of Plenty Regional Council, and Environment Canterbury. Physiographic mapping for contracted regions in the North Island commenced in early 2018, including development of hydrological process attribute and redox process attribute layers. In addition, a high-resolution sediment layer is currently being developed for Northland Regional Council due to the particular importance of sediment loss for the region. This work leverages off existing geospatial layers including a radiometric survey of the region.

University of Canterbury and Lincoln University: Waterways Centre for Freshwater Management

Envirolink medium advice grant

Contact: clint@landwatersci.net

Clint Rissmann completed an Envirolink medium advice grant for Northland Regional Council to assess the suitability of national datasets for physiographic mapping for the region (Rissmann et al., 2017). Attributes within national soil (FSL), geological (NZLRI, QMAP), topographical (DEM), and hydrological (REC) datasets were identified to recognise landscape gradients specific to water quality. These attributes were compared against radiometric imagery which is a direct measure of the spatial heterogeneity of the land surface and is relevant to deciphering the key landscape controls over water quality.

Rissmann, C., Marapara, T., Bloomberg, S., Lindsay, J., and Pearson, L., 2017. Evaluation of geospatial datasets and recognition of landscape gradients specific to water quality. e3 scientific Report for Northland Regional Council. December, 2017. 99p.

Envirolink small advice grants

Contact: clint@landwatersci.net

Envirolink small advice grants regarding provision of technical advice were undertaken for Tasman District Council (Lovett and Rissmann, 2018a) and West Coast Regional Council (Lovett and Rissmann, 2018b). The primary aims of these projects were to engage with regional council staff to transfer knowledge on the application of physiographics to the West Coast and Tasman regions. This engagement was essential to allow regional council staff to better understand the physiographic approach, the work required in application of the science, and potential benefits for water resources management at a regional and catchment scale. Both Envirolink projects were directly aligned with the PENZ Research Programme (2017 – 2019).

Lovett, A. and Rissmann, C. (2018a) Evaluation of the physiographic method for the Tasman Region. Land and Water Science Report 2018/04. 26p.

Lovett, A. and Rissmann, C. (2018b). Advice for application of the physiographic method to the West Coast Region. Land and Water Science Report 2018/08. 6p.

Tasman District Council

COMPILED BY: **Martin Doyle, Brenda Clapp and Matt McLarin**

A month of storms in Tasman

During February Tasman and Nelson were impacted by two ex-tropical cyclones, Fehi and Gita. The storms were different in nature but both caused extensive damage.

Fehi arrived on February 1st, and brought onshore strong winds, swells, low atmospheric pressure and moderate rainfall. A storm surge of 600 mm coincided with a very large 4.5 m tide and large waves to badly damage our coastline and nearby properties. Our region has several large bays that are open to the north, and water is funnelled to the top of these in a northerly wind and 'piles up' at the head of the bays, and this exaggerates the sea level rise from the storm.

Gita reached Tasman District on February 20th and brought less wind, but greater storm surge overall. Luckily the predicted tide was much lower on this occasion and coastal damage was consequently less. Several areas of high intensity rainfall occurred during Gita which caused damage not seen during Fehi.

The storm surge measured during Gita was 300mm higher than during Fehi, but didn't coincide with a high tide. The predicted tide during Fehi was some 180mm less than the maximum possible predicted tide, so a theoretical sea level some 500 mm greater than we saw during Fehi is possible, should the moon, planets and storms align. The effects of this could be catastrophic.

The main cause of the damage from Gita was a narrow band of intense rain. This was focused in a strip about 20 km long by 2 km wide starting in Marahau, crossing the lower Riwaka Valley and up the West Bank of the Motueka River to about Rocky River. Only one raingauge captured any of this information; the Council raingauge at Woodmans Bend (Peach Island, lower Motueka Valley) measured 61 mm in one hour. Based on the damage recorded, it seems highly likely that this gauge was on the edge of the rain band, and intensities were even higher just inland.

From HIRDS, the rainfall at Woodmans Bend had a 1% AEP for durations of 30 min, 60 min, 2 hours, 6 hours and 12 hours. Given the 12 hour total was so significant, and as the rain was heaviest near the end of the storm, it can be seen that this is a particularly damaging event as the ground was especially sodden before the heaviest rain even started – keeping in mind the rain was heavier away from this raingauge.

Another area of intense rain occurred across the Upper Takaka area, approximately from the Asbestos Mine to Sams Creek, and also in the Kaituna Valley to the West. Heavy rain occurred from Rocky River to Woodstock and up the Dove Valley, and also around the Abel Tasman coastline to Totaranui.

The worst of this heavy rain fell on the Separation Point Granite geology, and extensive slope failure triggered debris flows down the steeper catchments, scouring out the upper channels. Lower down, where it is less steep, the channels infilled and blocked causing the flow to breakout across the lower catchment depositing large amounts of boulders, logs, sand, silt and other debris. Some landslides directly impacted roads and houses with numerous road closures, and debris flows and floodwaters washed away bridge approaches.

A massive flood in the Upper Takaka Valley was recorded as 909 cumecs at the Harwoods flow recorder. The previous highest recorded flow in the 39-year record was 689 cumecs during the July 1983 flood, although it seems likely that the flood of March 1954 (prior to when recording commenced) was larger again, when 420 mm of rain was reliably measured over a 20-hour period at the Cobb Dam during its construction.

The Gita flood washed away the approaches to the first bridge on the Cobb Road, and briefly caused fears of flooding in Takaka Township. Fortunately the heavy rain didn't extend down the Takaka Valley, and the 'short and sharp' nature of the flood meant that it didn't coincide with large floods also occurring in the Waingaro and Anatoki catchments, and these fears were quickly dispelled.

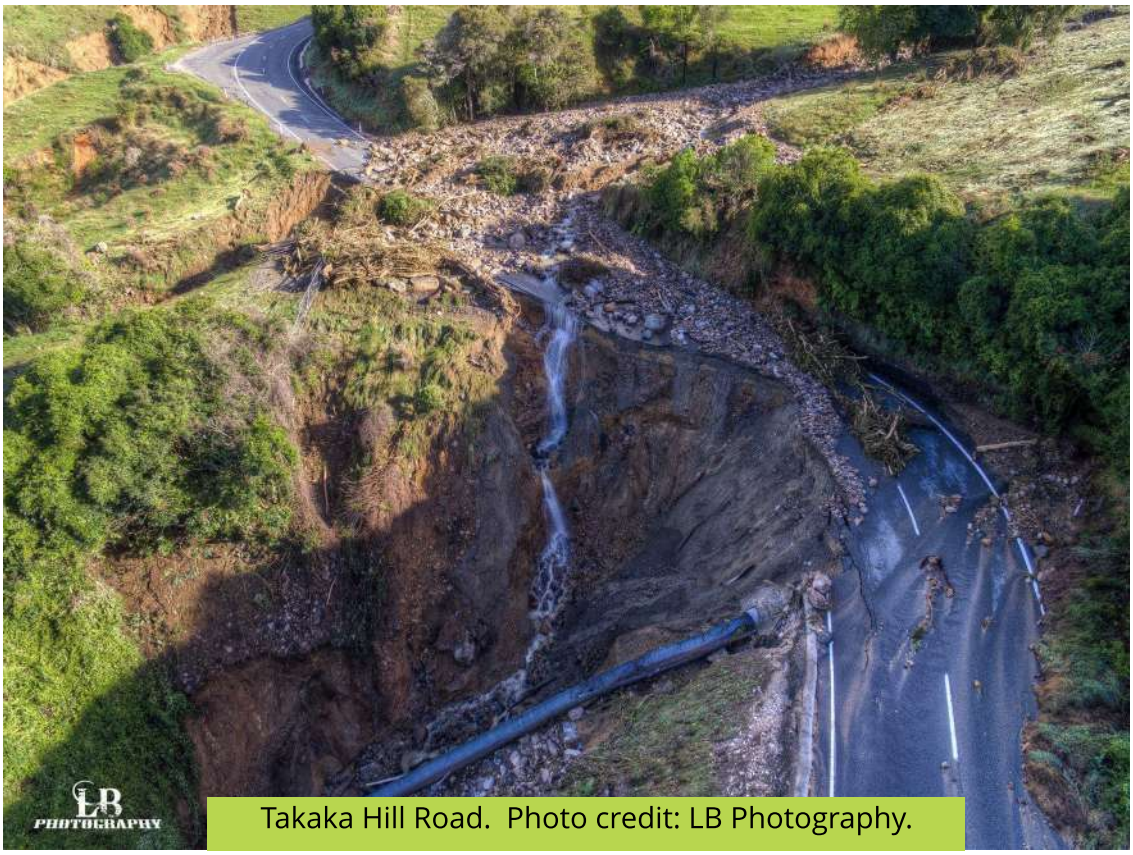
Separation Point Granite

The Separation Point Granite geology, which is prone to erosion and slope failure, extends from Ligar Bay and the northern extent of Abel Tasman National Park south-westwards down the length of the District. Much of this area is also vulnerable to storms from the northeast. Debris flows have occurred previously, most notably during August 1990 in the Brooklyn area, May 2010 around Tapawera, December 2011 around Ligar and Wainui bays, April 2013 at Anatoki, and June 2013 along the west bank of the Motueka. Slope failures occurred in the granites around Marahau and Otuwhero Inlet during June 2013, damaging houses and unfortunately resulting in a fatality. Debris flows are likely to have occurred during other historic storm events, but are not recorded as such.

The Council flood warning team considers whether slips are possible in these slip prone areas both prior to, and during a storm, and informs CDEM. This is an area of ongoing improvement in forecasting, along with need for continuing education of residents in slip prone areas.

Staff Changes

Maybe it was Cyclones Gita and Fehi that made Rob think about what he'd be missing, or maybe he felt we all needed more guidance, but Rob Merrilees agreed to stay on for another 6 months past his long stated retirement date of May. This is excellent news for our team as Rob is one of the most experienced and enthusiastic field hydrologists in the country. While we're going to miss Rob's knowledge and keenness for field work when he does leave, we also look forward to bringing someone new into our team when we advertise shortly.



Takaka Hill Road. Photo credit: LB Photography.

House near Marahau. Photo credit: Martin Doyle.

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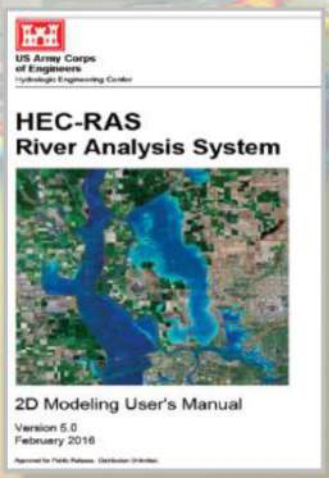

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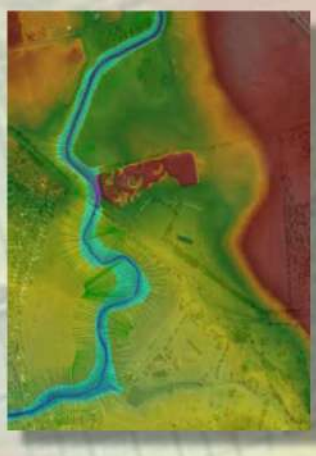
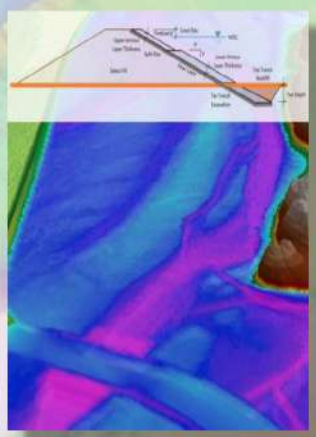


Day 1-2 Instructor: Dr. Steven Joynes, Golovin

Steven has over 30 years' experience in rainfall runoff modelling, hydraulic design, and flood mapping. He has conducted HEC-HMS and HEC-RAS training courses in New Zealand since 2011.

Day 3-4 Instructor: Krey Price, SWS

Krey is a civil engineer with a 20-year, international career focussed on river mechanics and hydraulic modelling. Krey has trained over 400 HEC-RAS 2D course attendees since the release of Version 5.0.



- **Day 1 Monday 11 June:** HEC-HMS Rainfall-Runoff
- **Day 2 Tuesday 12 June:** HEC-RAS 1D Hydraulics
- **Day 3 Wednesday 13 June:** HEC-RAS 2D Model Setup
- **Day 4 Thursday 14 June:** HEC-RAS 2D Model Results

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Funded project updates

The Society is currently supporting several students through funding grants to assist with their studies. Here are two updates from students.

A comparison of methods for estimating groundwater-surface water interactions in braided rivers

Katie Coluccio, MWRM Candidate, University of Canterbury

I received a research grant from the NZHS to support equipment costs for my Masters research, which involved comparing the effectiveness of methods for investigating groundwater-surface water exchange in the Ashburton River in South Canterbury.

Katie with temperature probe installed in river. Photo credit: Peter Joynt.

Sampling mini-piezometers.
Photo credit: Laura Jack

I installed mini-piezometers into the riverbed and margins in two horizontal transects to measure the hydraulic gradient between the river and shallow groundwater. I used vertical temperature probes to measure temperature at several depths in the streambed, from which I estimated streambed seepage direction and flux. I also carried out chemical analysis of the river and shallow groundwater.

The results showed that surface water and groundwater exchange processes at the study site are complex, and in this respect, the multi-method study design was beneficial. The study successfully demonstrated the usefulness of several tools for use in braided rivers – an environment that often poses challenges for measuring groundwater-surface water exchange. My thesis has now been submitted, and I will begin a PhD in the coming months. Many thanks for the NZHS support of this research project.

Surveying location of mini-piezometers.
Photo credit: Peter Joynt

Katie received a grant-in-aid of research from NZHS ($400) for purchase of equipment.

Impact of allocation on water through the Pool Burn

Henrietta Jackson, University of Otago

My Masters research was focused on characterising the current hydrological state of the Pool Burn, an impacted reach in Central Otago. Longitudinal and seasonal variations of key hydrologic parameters, including flow, morphology, temperature, and quality were observed between 2016 - 2017. During the summer period, the flow regime of the Pool Burn was dominated by low flows, varying between 0.04 - 0.14 cumecs across all monitoring sites. A shift in a phosphate dominated stream system during the warmer seasons to a nitrate and ammonium dominated system in the cooler seasons was evident for the Pool Burn, and was primarily attributed to the lack of riparian planting and the greater export of nutrients to and from the stream. The results from the research have highlighted the importance of adopting an integrated approach to understand the state of heavily influenced streams, where a simple minimum flow approach may not always ensure connectivity. For the Pool Burn, regular releases from the water storage infrastructure and an integration of riparian vegetation will likely improve the current state of the stream.

Student travel and project grants for 2018

So far in 2018 the NZHS executive committee has awarded the following travel grant:

Hisham Zarour received a travel grant ($1300) to attend the 21st International Water Technology Conference in Egypt in June. Hisham has developed a method to incorporate hydraulic properties heterogeneity in groundwater flow models which he is presenting.

You can find more information about

the Society awards and grants

on the NZHS website

Thanks from OXFAM

OXFAM New Zealand

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NZHS recently made a donation of $1600 to OXFAM NZ, which was collected with the 2017/2018 subs. Historically the $10 voluntary donation has been collected with subs payments and then passed on to Oxfam. Previously our donation was to the Water for Survival programme, which still runs but is no longer open for donations. NZHS had chosen the "Water: the key to surviving El Nino" programme as our designated fund, but on contacting Oxfam we were told that the programme had just closed for donations. So for this year the funds went to the Cyclone Gita fund, with the focus being the provision of clean water supplies to the people affected in Tonga.

Oxfam were delighted with our contribution and want to convey their thanks to the members who donated.

YOU stood with Tonga through Cyclone Gita.
Because of you, they're
rebuilding stronger than ever

Cyclone Gita ripped through the Pacific in February 2018, first hitting Samoa, then moving on to strike Tonga with full force.

It was the biggest cyclone to hit Tonga in living history. Because of your incredible support, Oxfam was able to help its Tongan partners prepare and plan for just this kind of event and deliver top-notch assistance for the cyclone response and long term recovery.

'Because of our amazing Kiwi donors, we were prepared,' says Darren Brunk, Humanitarian Specialist. 'We had supplies stationed in Tonga ready to be deployed by well-trained Tongan partners. You saved lives. Thank you!'

Oxfam's immediate priority was ensuring that safe, clean water was accessible. Dengue fever had broken out in the month before the storm, so it was crucial that sanitation and hygiene was a top priority to stop its spread.

As sea waters rise and warm up, cyclones are becoming more violent and less predictable. Our Pacific neighbours are most at risk.

The next steps are to hand out additional Water, Sanitation and Hygiene (WASH) kits, seedlings and equipment to ensure recovery and food security for Tongan communities in the future.

It is through your support that we can be there, on the ground, helping in crisis like these.

Thank you!

Please consider paying the voluntary OXFAM donation with your 2018/19 subs

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