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Waterways
Centre for Freshwater Management

2015 Postgraduate Student Conference

17 November
Lincoln University,
Christchurch, New Zealand

Abstract Booklet

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The Waterways Centre for Freshwater Management is a teaching and research centre, jointly supported by the University of Canterbury and Lincoln University. Established in 2009, it aims to improve the knowledge-driven management of freshwater resources by offering a full complement of nationally accredited tertiary courses and actively supporting postgraduate research programmes.

Conference Programme

Time	Presentation	
8:30	Registration	
9:00	Introduction – **Jenny Webster-Brown**, Director, Waterways Centre for Freshwater Management	
9:05	Welcome – **Stefanie Rixecker –** Deputy Vice Chancellor – Scholarship and Research, Lincoln University	
9:15	Phormidium accrual cycles in Canterbury cobble-bedded rivers: the relative importance of nutrients and flow	Tara McAllister, PhD Candidate, University of Canterbury
9.30	Incorporating stream ecology into edge-of-field nitrate management with denitrification bioreactors	Brandon Goeller, PhD Candidate, University of Canterbury
9:45	Glacial suspended particulate matter: compositional and behavioural change in freshwater environments	Phil Clunies-Ross, PhD Candidate, University of Canterbury
10.00	Distribution and feeding trials of Kekewai, the native freshwater crayfish (Paranephrops zealandicus) in Canterbury	Channell Thoms, Masters Candidate, University of Canterbury
10:15	The influence of pavement type on airborne pollutant wash– testing and developing tools for macrophyte control in Canterbury agricultural waterways	Katie Collins, PhD Candidate, University of Canterbury
10:30	Assessing the source and transformation of nitrogen compounds in a low lying urban drainage stream in Christchurch (Haytons Stream)	Fabio Cabral Silviera, Masters Candidate, University of Canterbury
10.45	**Morning Tea**	
11.15	The evolution and environmental history of Wainono Lagoon, South Canterbury	Maki Norman, Masters Candidate, University of Canterbury
11.30	Validation of daily operational satellite-based rainfall products over data-sparse Cuvelai Basin (Namibia) using two flood events	Frans Persendt, PhD Candidate, University of Canterbury

11.45	Characterisation of potential pollution distribution sources in the Waipara river catchment: North Canterbury, New Zealand; using Soil and Water Assessment Tool (SWAT) towards a better water quality management strategy	Hayford Ahiadu, PhD Candidate, Lincoln University
12.00	The effect of high lake levels due to climate change on lake-side communities and land-use	Dalia Zarour, Masters Candidate, Lincoln University
12:15	Monitoring hapua outlet dynamics	Richard Measures, PhD Candidate, University of Canterbury
12:30	Decision making framework for post-earthquake restoration of sewerage systems.	Melanie Liu, PhD Candidate, University of Canterbury
12.45	**Lunch; Poster Session from 1:00 pm**	
1.30	Quantifying the addition of nitrogen to agricultural land by groundwater irrigation	Sarah Hayman, Masters Candidate, University of Canterbury
1.45	Yield response to service interruption	Christopher Ruigu, Masters Candidate, University of Canterbury
2:00	Dairy farmers' management of fenced riparian areas: a Canterbury, New Zealand, case study	Abigail Mark, Masters Candidate, Lincoln University
2.15	Soil transport under winter forage crop grazing on hillslopes	Veronica Penny, Masters Candidate, Lincoln University
2.30	Elevated arsenic in Canterbury groundwaters	Ashlee Dolamore, Masters Candidate, University of Canterbury
3:00	**Afternoon Tea**	
3:30	The impact of heavy metals on benthic invertebrates in Christchurch's urban streams	Jason Eden, Masters Candidate, University of Canterbury

3.45	Predicting stormwater pollution from urban surfaces in christchurch	Frances Charters, PhD Candidate, University of Canterbury
4.00	Metal contamination in streams in three NZ cities, their accumulation in benthic communities and implications for mahinga kai	Malea Zygadlo, Masters Candidate, University of Canterbury
4:15	Nitrous oxide (N2O) fluxes and origins in agricultural drainage waters	Manjula Premaratne, Masters Candidate, Lincoln University
4:30	The flooding of Greywater Gully at Vanda Station	Peter Taylor, Masters Candidate, University of Canterbury
4:45	Impact of antimicrobial compounds on urban waterways receiving sewer overflows	Gemma Wadworth, Masters Candidate, University of Canterbury
5:00	**Drinks and Nibbles; Prize Presentation**	

Presenters and student committee members can be identified by coloured name tags. Presenters are keen to hear your questions and feedback, so please feel free to approach them throughout the day. Also, please let a committee member know if you need any assistance.

Posters next page

Posters

Poster Title	Presenter
MCPA degradation by nitrate reducing bacteria	Deepak Chouhan, PhD Candidate, University of Canterbury
Photoacclimation of leaves of *Stukenia pectinata* to different irradiance	Qian Hu, PhD Candidate, University of Canterbury
Fluid practices: understanding adaptations to material change in everyday water use	Julie Clarke, PhD Candidate, Lincoln University
Flood regime changes in the Mekong River Floodplain as impacted by future hydropower development	Dang Duc Thanh, PhD Candidate, University of Canterbury
Co-limitation of phytoplankton by light and nutrients in Te Waihora/Lake Ellesmere: a mesocosm bioassay study	Emma Mackenzie, Masters Candidate, University of Canterbury

Poster presenters can be identified by coloured name tags. There is a scheduled poster session in the foyer from 1:00 to 1:30 pm where all poster presenters will be available at their poster for questions and discussion. However, please feel free to approach poster presenters throughout the rest of the day.

Welcome

Hello Everyone

Welcome to the Waterways Postgraduate Student Conference

I would like to warmly welcome everyone to the 2015 Waterways Postgraduate Student Conference. We look forward to this great day every year. It is an opportunity to showcase highlights of freshwater related research being undertaken by postgraduate students at our two Canterbury universities. Through oral presentations and posters, our students will be presenting their research on freshwater systems, on policies that affect, or could affect, water use and management, and on potential solutions to freshwater problems.

It is a day when those who have supported the Waterways Centre get to see the tangible results of their support, and it is our chance to say thank you. It also provides an opportunity for students to talk to community, industry, economic, regulatory, consultancy and research stakeholders in the freshwater resources of Canterbury and New Zealand.

This day is entirely organised by a very dedicated committee of capable Waterways Centre Masters and Doctoral research students. We greatly appreciate their efforts and they deserve all of the compliments that I am sure will come their way. I hope you will end the day feeling some confidence that the future of NZ's water resources is in good hands!

Enjoy your day!

Professor Jenny Webster-Brown
Director - Waterways Centre for Freshwater Management

Dr Stefanie Rixecker, Lincoln University

Stefanie Rixecker is the Deputy Vice-Chancellor, Scholarship and Research at Lincoln University and has been engaged with tertiary education and the not-for-profit sectors for over twenty years.

Stefanie's experience includes roles as an academic, Dean, Assistant Vice-Chancellor, Board Director and Board Chair in New Zealand and overseas. She is past Chair of Christchurch Educated, and current member of other boards such as the Higher Education Teaching and Learning Executive Advisory Group (International Body), the New Zealand Agricultural Greenhouse Gas Research Centre, Lincoln Agritech Limited, the Bio-Protection Research Centre, and the Rangi Ruru Girls' School Board. She is a past Chair of Amnesty International New Zealand and one of three independent governance advisors to Amnesty International globally.

Oral Presentation Abstracts

Phormidium accrual cycles in Canterbury cobble-bedded rivers: the relative importance of nutrients and flow

Tara McAllister

Waterways Centre for Freshwater Management,
University of Canterbury,
tara.mcallister0@gmail.com

Blooms of the benthic cyanobacterium Phormidium are becoming increasingly prevalent in New Zealand's rivers. Phormidium can produce potent neurotoxins and has consequently resulted in approximately 100 dog deaths in the last five years. Despite the significant health risk, the development of effective management strategies is hampered by a limited understanding of how physiochemical factors influence Phormidium. The study aimed to investigate spatial and temporal variation of Phormidium in Canterbury rivers and to elucidate the importance of physiochemical factors in regulating Phormidium accrual. Eight sites were sampled weekly for 30 weeks. Samples were collected for species identification, biomass estimation, molecular and toxin analyses, nutrients and metals analysis.

Preliminary analysis indicated that water column nutrients are a poor predictor of Phormidium biomass. Nitrate concentrations, across all sample sites, varied between 0.02–1 mg/L, whereas dissolved reactive phosphorus (DRP) was consistently <0.01 mg/L. We have previously shown that Phormidium mats may access sources of P other than river-water DRP, and here we explore the hypothesis that nitrogen-fixing microorganisms may be present within Phormidium mats and that the quantity of these varies according to surrounding nutrient concentrations, which in turn influence Phormidium accrual.

Two patterns were observed between river flow and Phormidium cover: (1) as flow decreased Phormidium cover increased; (2), as flow decreased Phormidium cover also decreased. The results of this study highlight the complex interplay between river flow, nutrient dynamics and Phormidium accrual in Canterbury rivers. Only by untangling these interactions can we hope to understand, and therefore manage increasing Phormidium proliferations.

Incorporating stream ecology into edge-of-field nitrate management with denitrification bioreactors

Brandon Goeller

Center for Integrative Ecology, University of Canterbury,
Brandon.goeller@pg.canterbury.ac.nz

Around the world, artificially-drained agricultural lands are significant sources of reactive nitrogen (Nr) to stream ecosystems, creating substantial stream health problems which could be abated with denitrification enhancement tools. Here, we evaluate the factors affecting the potential of denitrification bioreactors to improve stream health and ecosystem services. Rehabilitating agricultural drains and streams with bioreactors can complement land-based Nr management and recognizes the value of these waterways as functional parts of the landscape, rather than just conduits of environmental pollutants.

Bioreactors' performance and the structure of stream biotic communities are linked by environmental parameters like dissolved oxygen and nitrate concentrations, dissolved organic carbon availability, flow rate, temperature, and fine sediment accumulations. However, evidence of bioreactors' ability to improve waterway health and ecosystem service delivery is scarce. To improve the potential of bioreactors to enhance desirable stream ecosystem functioning, future assessments of field-scale bioreactors should evaluate the influences of bioreactor construction and performance on ecological indicators such as primary production, leaf litter processing, stream metabolism, and invertebrate and fish assemblage structure. These stream health impact assessments should be conducted at ecologically-relevant spatial and temporal scales.

Bioreactors have great potential to make significant contributions to improving water quality, stream biodiversity, and ecosystem services if they are tailored to site-specific conditions and implemented strategically with land-based and stream-based mitigation tools within watersheds. This will involve combining economic, logistical, and ecological information in their implementation.

Glacial suspended particulate matter: compositional and behavioural change in freshwater environments

Phil Clunies-Ross

Waterways Centre for Freshwater Management, University of Canterbury,
phil.clunies-ross@pg.canterbury.ac.nz

The dissolved concentrations of many toxic trace metals, nutrients and organic contaminants are strongly influenced by sorption-desorption processes on the surfaces of suspended particulate material (SPM). Because such pollutants are more bioavailable to aquatic biota in their dissolved form, the partitioning of trace contaminants and nutrients onto suspended particles is an important process regulating their transport, availability and toxicity.

Glacial melt-water is an important source of freshly eroded sediments that suspend in melt-waters for extended periods and are susceptible to weathering processes. These particles may play an important role in regulating water quality as glacier-fed catchments are subject to increasing levels of pollution and hydrological changes caused by climate change.

The aim of this research is to determine the composition and behaviour of SPM in glacier-fed catchments, and examine whether this differs from non-glacier fed catchments. To date, the characteristics and adsorptive capacity of SPM in the Waitaki catchment has been investigated between the upper glaciated catchment (Aoraki/Mt Cook National Park) and the lower, agricultural catchment. Five large hydroelectric lakes increase the residence time of SPM to approximately 1 - 2 years, optimizing opportunities for particle characteristics to change.

Changes in the mineralogical character of the SPM with time have been detected, and include an increase in the proportion of clay minerals and diatoms to feldspar and quartz minerals. The capacity of upper and lower catchment SPM to adsorb copper, cadmium and phosphate has been assessed through adsorption experiments that will be discussed.

Distribution and feeding trials of Kekewai, the native freshwater crayfish (Paranephrops zealandicus) in Canterbury

Channell Thoms

School of Biological Sciences, University of Canterbury,
channell.thoms@pg.canterbury.ac.nz

Freshwater crayfish are a taonga species of New Zealand waterways that are highly valued as mahinga kai by many local iwi. Crayfish can also be an important keystone species by acting as bioengineers that create habitats for other species as well as contributing to the maintenance of stream health. Crayfish are also ideal candidates as bio-indicators in freshwater ecosystems due to their sensitivity to environmental pollutants; they are adaptable to changes physiologically and behaviourally, while still remaining susceptible and sensitive to stressors.

My research focuses on the native South Island crayfish (Paranephrops zealandicus) and comprises three components; field surveys to determine the occurrence of crayfish in Canterbury streams, testing of alternative sampling techniques and investigating feeding.

My initial field surveys indicate a very patchy distribution of crayfish throughout the region, with some historic sites having possibly lost crayfish populations. Comparison of contemporary and traditional methods for capturing crayfish indicate differences in catch rates seasonally and various trapping biases. My feeding trials have focused on consumption rates and food preferences. Initial experiments examined the palatability of various foods including macrophyte species, detritus and invertebrates (i.e. mayflies and snails).

Although it is commonly accepted that crayfish are opportunistic omnivores, there has been very little research investigating food palatability in native New Zealand crayfish. Preliminary results show that crayfish will consume some invasive macrophytes. Future research could investigate crayfish diet as a potential bio-control for some of these invasive macrophytes.

The influence of pavement type on airborne pollutant wash – testing and developing tools for macrophyte control in Canterbury agricultural waterways

Katie Collins

Freshwater Ecology Research Group, School of Biological Sciences, University of Canterbury.
katie.collins@pg.canterbury.ac.nz

Water conveyance is the primary function of agricultural drainage ditches in lowland Canterbury. Aquatic macrophytes can provide important functions in stream ecosystems, but excessive macrophyte growth can have negative impacts and often impedes drainage. When drains become choked during summer months, management typically involves mechanical clearance involving a bank-side digger with scoop bucket to excavate plants from channels. This practice can over steepen banks, damage in-stream habitat and hinder aquatic ecosystem function.

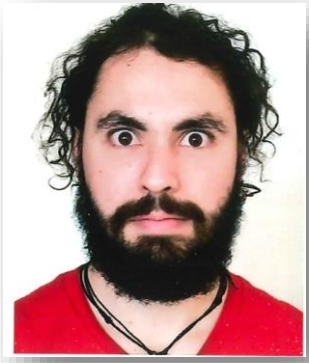
We evaluated tools including: hand weeding, herbicide spray, weed mat, channel shading, flower and seed removal, sediment removal and physical disturbance, to control macrophytes at a small-scale in Canterbury agricultural waterways. Hand weeding, weed mat and herbicide spray provided effective reductions in macrophyte growth. Macrophyte growth was enhanced under a partially shaded channel, however under full shade across the channel (with 70% light reduction), growth was severely limited. Results of flower and seed removal are not expected to be seen in the short-term.

Future experiments will look at timing, shade thresholds and synergistic effects between multiple treatments to develop a toolbox to improve waterway management strategies for macrophytes.

Assessing the source and transformation of nitrogen compounds in a low lying urban drainage stream in Christchurch (Haytons Stream)

Fabio Cabral Silveira

Department of Civil and Natural Resource Engineering, University of Canterbury
fabiocabralsilveira@gmail.com



Ammonia concentrations at selected water sampling points at Haytons Stream (Christchurch, New Zealand) were found to be high (up to 100 g/m3) compared to natural stream water (0.01 – 0.1 g/m3). High levels of ammonia and/or related nitrogen compounds can be toxic to aquatic organisms and can have a significant effect on the stream's ecological health. Nitrogen compounds can change phases and chemical form as they interact with the environment. Numerous environmental and physical factors, such as stream organic matter content, stream hydrology/hydraulics, temperature, sediment and interactions with other contaminants (e.g. chlorine) can cause dissociation or dilution of nitrogen compounds along the stream. Research is necessary to identify the source and fate of nitrogen compounds in Haytons Stream, to evaluate their potential environmental impacts, and to understand the transformation processes which may occur along the stream.

The aim of this project is to assess the sources, types, and transformation of nitrogen compounds in Haytons stream through water quality monitoring at various locations along the stream and over time. Knowledge gained from this project will be used to make recommendations as to best management practices to mitigate nitrogen compound impacts in stream.

The evolution and environmental history of Wainono Lagoon, South Canterbury

Maki Norman

Department of Geography, University of Canterbury, maki.norman@pg.canterbury.ac.nz

Coastal lagoons are dynamic and sensitive to climate change, sea level rise and human activities including catchment water-resource and land use. Their management is of high public and scientific interest at present, both locally and internationally, not least due to widespread water quality declines associated with freshwater resource use in feeder catchments. In addition to water quality, key lagoon management issues include loss of ecological and economic values, land loss with shoreline retreat, and inundation risks (e.g. Gonenc & Wolflin, 2005; Philomena, 1994; Pye & Blott, 2009). Waituna-type coastal lagoons have featured strongly in local debates around catchment management, including in relation to Waihora Lake Ellesmere in central Canterbury, and Waituna Lagoon in Southland, with Waituna being a common feature of the high-energy mixed sand and gravel coasts of New Zealand. Less research has focussed on smaller examples of Waituna, including Wainono Lagoon in South Canterbury. This research investigates the morphology and dynamics of Wainono Lagoon over recent years and historical time with the aim of contributing towards a better 'understanding for management purposes' of this feature.

The evolutionary and environmental history of Wainono lagoon is reconstructed using a multi-disciplinary approach, including analyses of sediment cores, foraminiferal assemblages, anisotropy of magnetic susceptibility, barrier profiles, lagoon bathymetry and aerial photographs. The main objective is to comprehend the complexity of the lagoon system and its various driving forces. The long-term stability of Wainono Lagoon is assessed in order to predict future trends in barrier morphology, lagoon size and shorelines. Comprehension of the evolutionary history and the effects of both natural and human induced environmental changes is crucial to understand the lagoon dynamics. This research has a holistic approach and aims to understand the lagoon system as a whole. This study will provide a better understanding of the dynamics of Wainono Lagoon as a basis for the development of management policy and strategies to avoid undesirable outcomes such as human induced infilling of the lagoon.

Validation of daily operational satellite-based rainfall products over data-sparse Cuvelai Basin (Namibia) using two extreme flood events

Frans Persendt

Geography Department, University of Canterbury,
Frans.persendt@pg.canterbury.ac.nz

Worldwide, more than 40% of all natural hazards and about half of all deaths are the result of flood disasters. In Northern Namibia flood disasters have increased dramatically over the past half-century, along with associated economic losses and fatalities. Reliable daily rainfall data are needed to predict and monitor these hydro-meteorological events but rain gauges are declining and scarce in some regions. Point measurements pose challenges for analysis that need accurate spatial coverage, as well as requiring the calculation of areal means due to the uneven distribution of point-based gauges and limited sampling area. As an alternative, satellite-derived, quasi-global coverage, uninterrupted satellite products with high spatial and temporal resolution have been available. However, these products cannot be implemented into the operational and policy-making applications in data-sparse regions, if uncertainties and the reliability at various scales are not quantified to ensure that they are compatible in terms of their statistical properties. This study used gauge as well as satellite products to validate how accurately they characterized two flood events (2009 and 2011). The results indicated good statistical relationships between the gauge stations and satellite products. The TRMM product performed the best overall spatial and temporal scales, while the CMORPH product overestimated these events significantly but reproduced the seasonal trend well.

Characterisation of potential pollution distribution sources in the Waipara River catchment: North Canterbury, New Zealand; using Soil and Water Assessment Tool (SWAT) towards a better water quality management strategy

Olusegun Hayford Ahiadu

Department of Environmental Management, Faculty of Environment, Society and Design, Lincoln University, olusegun.ahiadu@lincolnuni.ac.nz,

Concerns about increasing nutrient loadings on surface and sub-surface water bodies as a result of cumulative effects of land uses is potentially a significant issue for most governments and organizations. The inherent variability in environmental factors within a catchment could thus reflect variability in water quality, not necessarily the land use. The contribution to water quality trends from land uses is therefore difficult to measure in such cases without sound data and catchment modelling, especially in land use change situations.

It has been argued that critical source area targeting method of watershed pollution control strategies might not guarantee water quality benefits at watershed scale (Arabi et al., 2006); unlike watershed scale conservation plans [Maringanti et al., 2011]. Critical source targeting emphasises differences across space whereas watershed-wide approach emphasise similarities across space (Arabi et al., 2007; Veith, 2002). Thus, watershed wide approach lead one into thinking that all parts of the catchment can be accurately represented by a single value whereas critical source targeting methods can show the falsity of this assumption by depicting what is actually happening in different parts of the region.

It is therefore the objective of this paper to employ the physically based modelling capabilities of SWAT to characterize the Waipara river catchment on an integrated critical source targeting and catchment-wide scale; towards a better understanding of the contributions of each sub units of the catchment to water quality. The result of the study shows that SWAT is able to represent the physical processes (precipitation, ET, PET, sediment and nutrient yield etc.) and points towards pollution sources in the catchment.

The effects of high lake level due to climate change on lake-side communities and land-use

Dalia Zarour

Waterways Centre for Freshwater Management and Faculty of Environment, Society and Design, Lincoln University, dalia.zarour@lincolnuni.ac.nz

Sea level rise due to the increase in global temperatures and the melting of the arctic will have a significant impact on many New Zealanders within their lifetime. Thus it is crucial now more than ever to have a well-informed management plan to respond to natural disasters such as flooding that may occur as a result of sea level rise.

My thesis is based and focused on Lake Ellesmere/Te Waihora which is located south-east of Christchurch and directly to the west of Banks Peninsula in the Canterbury Region of the South Island of New Zealand. It is Canterbury Region's largest and New Zealand's fifth largest lake. The lake is separated from the sea by a 28km long sandy/shingle spit (Kaitorete Spit) and is artificially opened to the sea to avoid flooding and for the adjacent land to be used.

In the case of Lake Ellesmere, sea level rise is going to have a cascading and cumulative effect on the lake-side communities and adjacent land-use. As sea level rises the lake level will rise and the hydraulic gradient between the lake and the sea will decrease, resulting in an increase in the risk of flooding for the lake-side communities and posing a threat to the viability of the current adjacent land-use.

To meet the aims and objectives of this research project both quantitative and qualitative analysis were carried out. The quantitative analysis revolved around examining the properties that will be affected around Te Waihora, by creating maps using GIS software, Arcmap 10.3. The maps represent a scenario of the current winter opening regime of the lake of 1.13 m.a.m.s.l. The qualitative analysis revolved around examining the lake-side communities' awareness and preparedness for coping with the effects of sea level rise. This was carried out by interviews with members of the lake-side communities.

Monitoring hapua outlet dynamics

Richards Measures

Department of Civil and Natural Resource Engineering, University of Canterbury, richard.measures@pg.canterbury.ac.nz

There has been much recent interest in Canterbury in the coastal interfaces between freshwater catchments and the sea, including the effects of freshwater use on these sensitive hydrosystems. Hapua are a locally common type of non-estuarine river mouth lagoon that forms where rivers discharge onto high wave energy low tidal range coastlines such as in North Canterbury and the Canterbury Bight. They are separated from the sea by mixed sand and gravel barrier beaches and have highly dynamic outlet channels which can rapidly migrate along-shore, change in width and length, or close for short to sustained periods of time. Hapua are associated with important ecological, cultural and recreational values, and hapua outlet morphology has a controlling influence on lagoon water quality, flood risks to adjacent land and diadromous fish passage.

In order to better understand hapua outlet processes, an intensive data collection campaign including surveys, water level and salinity monitoring, and time-lapse photography is being conducted at the Hurunui hapua in North Canterbury. Post processing this data allows measurement of outlet morphology and hindcasting of outlet flow rates. Data collection is ongoing but initial analyses are already providing insight into the balance between wave, river flow and tidal influences on outlet and barrier morphology. The overall aim of this research is to allow better prediction of the effects of river flow regime changes on hapua, allowing more informed decision making.

Decision making framework for post-earthquake restoration of sewerage systems

Melaine Liu

Department of Civil and Natural Resources Engineering, University of Canterbury,
Melanie.liu@pg.canterbury.ac.nz

Earthquake events can cause physical damage and functional impacts on wastewater system components, causing partial or total dysfunction of the entire system. This presentation introduces a framework for supporting the decision making process towards post-earthquake restoration of wastewater systems. The proposed decision support framework builds on the experience and learning of the Stronger Christchurch Infrastructure Rebuild Team in reinstating the resilience of the Christchurch wastewater system following the Canterbury Earthquake sequence in 2010-2011.

The proposed decision support framework includes three modules, namely: 1) Physical Damage Module (PDM); 2) Function Impact Module (FIM); 3) Restoration Module (RM). The PDM assesses and estimates the earthquake-induced physical damage to wastewater system components. The FIM evaluates, through a set of specific performance indicators (PIs), loss of wastewater service and the induced functional impacts in three different phases: emergency response, short- and long-term recovery. The RM looks into alternative recovery strategies, aiming to maximise a resilient recovery. The possibility to integrate the proposed decision support framework with business-as-usual asset management tools is further discussed in the presentation.

Quantifying the addition of nitrogen to agricultural land by groundwater irrigation

Sarah Hayman

Waterways Centre for Freshwater Management, University of Canterbury, Sarah.hayman@pg.canterbury.ac.nz

Significant nitrogen concentrations in Canterbury's groundwater have initiated the need for more effective management techniques. The aim of this research is to quantify the potential of nitrogen in groundwater to partially replace nitrogen fertilisers for on-farm nutrient management benefits. By using groundwater as an alternative source to nitrogen fertilisers, this could reduce the amount of nitrogen that is present in the groundwater and reduce fertiliser costs. Farmers will essentially be recycling their nitrogen input that is contributed to agricultural land.

The Canterbury region is where this research is focused, particularly looking at the Ashburton and Selwyn Districts. All participating farms used groundwater for irrigation and had a significant nitrogen input. Monthly water samples were taken and analysed for nitrate-nitrogen concentrations. This data was then used to calculate the nitrogen contribution from irrigation groundwater for each farm and these calculations were compared to the total amount of nitrogen fertiliser applied to the farm. The strategic management tool, OVERSEER, was also used to produce nutrient budgets for three scenarios that involved applying different amounts of nitrogen from irrigation groundwater. From these results, recommendations were made to the participating farmers on how they can effectively manage their nutrient use on farm. This information can be used in Farm Environmental Plans and for complying with nutrient limits set in Environment Canterbury's Land and Water Regional Plan.

Yield response to service interruption

Christopher Ruigu

Waterways Centre for Freshwater Management,
University of Canterbury,
christopher.ruigu@pg.canterbury.ac.nz

The Warabandi System is a method that is used to supply water to irrigated farms in the Indus Basin Irrigation System. The core value of this system is to offer protective irrigation by spreading available water to an area as large as possible and to do so equitably. Therefore by design, there is water shortage. There is also a shortage in water supply from the rivers in the region due to climatic variability.

This has led to the need for the irrigation authorities in the basin to selectively open and close canals while maintaining equitable water supply to all farmers in the scheme. However, this was not the case; studies carried out in Hakra Branch Canal command area have conclusively shown that the existing schedules have led to inequity in water supply. The inequity has been as a result of a canal delivering less than optimum amount of water and sometimes no water at all; service interruption.

The Equitable Canal Water Allocation (ECWA) model was developed using linear programming to schedule water supply in canals while addressing equity. The aim of this research is to couple these new schedules with a crop growth model to determine their effect on yield. The crop model selected for this research is AquaCrop from FAO. The crops selected were cotton, wheat, rice and sugarcane as they are all important to farmers in the region.

Dairy farmers' management of fenced riparian areas: a Canterbury, New Zealand case study

Abigail Mark

Waterways Centre for Freshwater Management, Lincoln University, abi.mark@lincolnuni.ac.nz

In intensive rangeland dairy landscapes riparian margins provide essential ecosystem services in support of healthy waterways. Dairy farm intensification often degrades these ecosystem services and increases dairy farming impacts on waterways. For example, stock access to waterways increases the amount of faecal bacteria entering waterways, degrading aquatic and semi-aquatic habitat and water-related recreation opportunities.

Riparian management strategies are being promoted by regulators and dairy companies as key to addressing some of the impacts of intensive farming, and as a way to demonstrate good stewardship. However, little is known about how farmers manage riparian areas, including if any vegetation is planted, what fencing is implemented or how these areas are managed after implementation.

Through key informant interviews with farmers, this research describes how riparian margins on dairy farms are being managed and evaluates their effectiveness for meeting dairy farmer, regulatory and industry goals and objectives. From this recommendations for improved riparian management can be provided.

Soil transport under winter forage crop grazing on hillslopes

Veronica Penny

Department of Soil and Physical Sciences, Lincoln University, Veronica.penny@lincolnuni.ac.nz

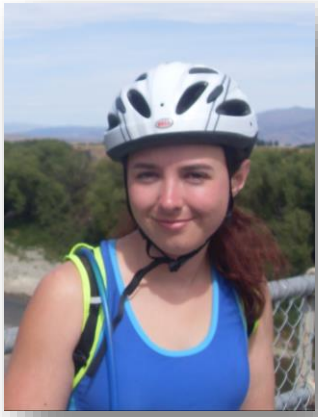
In New Zealand, the major contributing source of sediment and nutrients causing poor water quality and eutrophication is agricultural land, and namely occurs through the processes of leaching and erosion. Soil resistance to erosion decreases with severe and continued trampling, such as occurs under intensive stocking rates, meaning that prolonged grazing periods are more likely to cause erosion to occur. Soil is also more susceptible to damage when under high water content conditions, as occurs over winter due to decreased evapotranspiration rates and/or increased precipitation. The feeding of brassica forage crops to stock over winter induces a high risk of soil damage and erosion occurrence due to the combined factors of exposed soil, high soil water content, and extremely high stocking density for long periods over winter.

The effect of cattle strip-grazing forage crops on soil transport of sloping land was examined using a novel technique, allowing direct quantification of soil physically pushed down slope under the hooves of the cows. The relationship of observed soil movement with slope gradient and soil water content was determined, allowing the calculation and modelling of soil transport under different paddock conditions. Avoidance of the use of areas determined to be at high risk of soil erosion for winter forage cropping will reduce transport of sediments and nutrients to waterways, and thus decrease eutrophication and improve fresh water quality.

Elevated arsenic in Canterbury groundwaters

Ashlee Dolamore

Waterways Centre for Freshwater Management,
University of Canterbury,
ashlee.dolamore@pg.canterbury.ac.nz



Arsenic exists naturally in sediment and marine water and trace amounts have been measured in groundwater in certain parts of Canterbury. Arsenic is toxic and the World Health Organisation guideline limit for drinking water is 10 µg/L. Concentrations exceeding this have previously been measured in at least 23 wells in Canterbury. Arsenic has been routinely monitored by Environment Canterbury for at least fifteen years but there has not yet been a thorough investigation into the mechanisms by which it enters groundwater.

The Canterbury Plains may have a similar depositional environment to countries such as Bangladesh, and West Bengal in India where young alluvial deposits host high arsenic groundwaters. The reductive dissolution of iron and manganese oxides is proposed to be the dominant mechanisms of arsenic release into groundwater in Bangladesh and West Bengal, and it is possible that this is also the case in Canterbury.

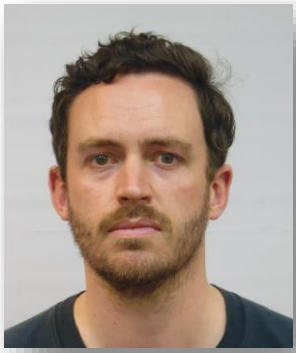
The primary aim of this research is to find out where arsenic is present in Canterbury and identify the mechanism of release into groundwater. Secondary aims include examining temporal patterns in arsenic distribution and possible variation in arsenic concentration with well depth.

Groundwater samples have been collected from 18 wells around Canterbury which were organised into 9 pairs. Results so far include a correlation between arsenic concentration and the concentration of iron and manganese. This supports the reductive dissolution mechanism which states that arsenic is sorbed to iron-oxide or manganese-oxide minerals in the sediments and is released into the groundwater when the iron/manganese oxide is reduced from FeIII/MnIII to FeII/MnII which is more soluble.

The impact of heavy metals on benthic invertebrates in Christchurch's urban streams

Jason Eden

Waterways Centre for Freshwater Management,
University of Canterbury,
Jase.eden@pg.canterbury.ac.nz



The impacts of urbanisation, often referred to as "urban stream syndrome", lead to a higher incidence of flash flooding, increased inputs of nutrients and contaminants, and a decrease of biotic richness with an increased dominance of "tolerant" species. Urban stream rehabilitation projects are common worldwide, yet most have had mixed results with little difference between rehabilitated vs degraded stream biological communities. It has been posited that high heavy metal concentrations could be one of the barriers to urban stream ecological rehabilitation projects. Elevated concentrations of heavy metals have been shown to be a significant factor in the structure of several impacted benthic invertebrate communities and can be toxic to a number of aquatic organisms in New Zealand.

My research aims to investigate the impacts of heavy metals on invertebrates and invertebrate communities in Christchurch's urban streams. To achieve this, a survey of Christchurch's urban streams was conducted, sampling water, sediment, and invertebrates; and measuring a suite of environmental conditions at each site. Qualitative and quantitative invertebrate sampling results can then be compared to environmental conditions and metal concentrations. An *in situ* mesocosm trial will be conducted with *Deleatidium* mayflies transplanted from a periurban stream into 6 urban stream sites, with growth and mortality rates compared to metal concentrations and environmental conditions after the two week trial.

Predicting stormwater pollution from urban surfaces in Christchurch

Frances Charters

Department of Civil and Natural Resources Engineering, University of Canterbury,
frances.charters@pg.canterbury.ac.nz

Sediment and heavy metal pollution is contributed to our urban waterways from the various impermeable surfaces we have around our city. These pollutants adversely affect aquatic health yet the diffuse nature of stormwater pollution creates difficulties in providing effective management solutions to reduce such pollution.

To help address this need, a pollutant load model has been developed to predict the amount of sediment and heavy metals from different surface types based on rainfall characteristics. A sampling programme in the Okeover catchment, a residential/institutional catchment in Western Christchurch, was completed to enable calibration of the model to Christchurch's low intensity, short duration rainfall conditions. The model has then been run for the Okeover catchment as an initial case study, with the Addington Brook catchment currently being modelled as second contrasting catchment of primarily industrial/commercial land-use.

The model maps where 'hotspot' areas of pollution are predicted so that stormwater improvement can be targeted to these areas of most need. It also allows users to implement different treatment scenarios on an individual-surface basis, to identify the load reduction that could be achieved.

Metal contamination in streams in three NZ cities, their accumulation in benthic communities and implications for mahinga kai

Malea Zygadlo

Department of Chemistry, University of Canterbury, malea.zygadlo@pg.canterbury.ac.nz

Heavy metals can be major contaminants in urban streams, resulting from the discharge of un-treated stormwater. Their ubiquitous nature and toxicity pose a threat to stream ecosystem health. High metal concentrations can be directly toxic to aquatic organisms, can accumulate in plants and sediment, and can enter stream food chains. An increase in metal concentrations can decrease diversity and alter the benthic invertebrate communities to metal tolerant species. Data available regarding the presence of metals in New Zealand urban waterways is generally limited in scope. To address this data gap, a field survey of the concentrations of heavy metals in water, sediment, algae and benthic invertebrate communities in 30 small urban streams in Auckland, Wellington and Christchurch was carried out. The bioaccumulation of a common Canterbury mayfly, Deleatidium, to specific metals Cu, Zn, and Ag and metal mixtures will also be investigated through contaminated feeding trials. The results of the survey will be discussed along with implications for mahinga kai species and stormwater management.

Nitrous oxide (N2O) fluxes and origins in agricultural drainage waters

Manjula Premaratne

Agriculture and Life Sciences, Lincoln University, manjula.premaratne@lincoln.ac.nz

Nitrous oxide (N2O) is a greenhouse gas which also impacts stratospheric ozone destruction. When agricultural nitrogen (N) inputs are out of balance with the agroecosystem demands, excess N may be lost as nitrate (NO3-), N2O and di nitrogen (N2) as a result of various microbial processes including nitrification and denitrification. Losses of N occurring directly from soils at the site of N input are considered as direct emissions, and are relatively well quantified. However, N leached beyond the plant root zone subsequently contaminates ground waters and may be transported into aquifers. The accumulated N leached into waterways or drainage sediment may be transformed into N2O and be released into the atmosphere. Such N2O emissions are considered as indirect N2O emissions and these are not quantified adequately.

Scaling of the exchange of N2O across the air – water interface in drains, streams and river systems is important to estimate N2O fluxes at temporal and spatial scales. This study was designed to quantify the stream rates and pathways for ammonium nitrification and ensuing N2O yield while measuring actual N2O transfer rate from water to air. The physical and chemical properties of the drainage water such as, N species, temperature, pH, dissolved oxygen and dissolved carbon forms were measured with N accumulation of biofilms and aquatic plants while assessing N2O yield.

The flooding of Greywater Gully at Vanda Station

Peter Taylor

Waterways Centre for Freshwater Management,
University of Canterbury,
peter.taylor@pg.canterbury.ac.nz

For 25 years, New Zealand's only mainland Antarctic station, Vanda Station, operated on the shores of Lake Vanda in the Wright Valley, McMurdo Dry Valleys. Throughout its operation, until removal in 1994, minor environmental chemical contamination occurred. This occurred due to unregulated disposal of greywater and poor management of petroleum resulting in spills and leaks. Greywater Gully was identified as the worst contaminated site in 1996/97. In 1999 this gully flooded for the first time and is now 3 meters underwater. This study, as a continuation of previous work, investigates residual contamination and environmental effects now that the lake has flooded affected soils. This research focusses around Greywater Gully, where sediment, porewater, and a profile of lake water along Greywater Gully were sampled and analysed. Contaminant release from affected soils, dispersion into Greywater Gully and the main waterbody of Lake Vanda, the effects on species composition and growth of benthic mats are investigated. Results, as they follow, will evaluate any ongoing environmental effects, the effectiveness of the remediation efforts at Vanda, and the assimilation of contaminants in Greywater Gully and adjacent Lake Vanda littoral zone.

Impacts of antimicrobial compounds in urban waterways receiving sewer overflows

Gemma Wadworth

Department of Chemistry, University of Canterbury,
gemma.wadworth@pg.canterbury.ac.nz

Pharmaceuticals and personal care products (PPCPs) are used every day in households resulting in the release of chemical ingredients, along with degradation products, into the environment. There is growing concern regarding the risk PPCPs, including antimicrobial compounds and parabens pose to human and ecosystem health. Personal care products can contain antimicrobial compounds which are designed to kill or prevent the growth of potentially harmful microorganisms. The release of domestic wastewater into streams via sewer overflows can result in non-target microorganisms being exposed to antimicrobial compounds. Resulting changes to the benthic microbial structures have the potential to alter the nutrient processing capacity and natural food web structure of affected streams. There is limited data available regarding the occurrence and impact of PPCPs in New Zealand waterways. This project aims to provide baseline data on the fate and potential effects of a suite of phenolic antimicrobial compounds including triclosan and paraben preservatives in two urban streams in the city of Christchurch, New Zealand. Water and sediment samples collected from two Christchurch urban streams at upstream and downstream sites of sewer overflow outfalls over a 6 month period will be analysed by GC-MS. The data obtained from the stream water and sediment samples will be discussed along with the implications for urban streams receiving inputs of these contaminants via waste water overflows.

Poster Abstracts

Poster Session from 1.00pm to 1.30pm in the foyer

MCPA degradation by nitrate reducing bacteria

Deepak Chouhan

Department of Civil and Natural Resources Engineering, University of Canterbury,
deepak.chouhan@pg.canterbury.ac.nz

Nitrates and pesticides are two non-desirable elements that sometimes end up in our drinking water sources. Removing these two constituents at once is a matter of concern. There is a significant gap in simultaneous removal of both of these micro contaminants using microbial communities. Because of this, the major aim of this research project was to investigate the use of activated sludge microorganism to simultaneously remove chlorinated herbicides- MCPA and nitrates under nitrate-reducing conditions. To obtain the required objectives, the research was divided into four phases consisting of Phase I (a "proof-of-concept" phase); Phase II (an initial "tolerance" exploration phase); Phase III (an "effect of hydraulic retention time (HRT)" phase) and Phase IV (a "limit" phase). The SBR successfully and simultaneously removed the nitrates completely and around 98 % of the MCPA (in the dimethylamine salt form) up to 50 mg/L (Phase I, II and III); however, it took approximately 28 days to observe the first removal of MCPA. When the concentration of MCPA was increased to 75 mg/L (Phase IV) the MCPA removal efficiency dropped to 85 % and the biomass appeared to eventually become saturated with the herbicide, stopping conversion of DMCPA to its acid form and halting biodegradation.

Photoacclimation of leaves of *Stukenia pectinata* to different irradiance

Qian Hu

Waterways Centre for Freshwater Management,
University of Canterbury,
qian.hu@pg.canterbury.ac.nz

To assist with development of a strategy for a successful transplantation of *Stuckenia pectinata* into Te Waihora/Lake Ellesmere, a highly turbid lake, the ability of the plant to photo-acclimate to different irradiances was investigated. In a laboratory experiment, leaves of S.pectinata that had been pre-acclimated to a photon flux of 55 µmol m-2 s-1, were exposed to 20, 50, and 210 µmol m-2 s-1. After 12 days of acclimation, leaves showed no significant differences in specific leaf area or light absorption, but leaves that acclimated to 210 µmol m-2 s-1 showed a significant reduction in chlorophyll content and an increase in carotenoids. Photosynthesis-irradiance curves were constructed for all treatments and showed that leaves of the plants acclimated to 20 and 50 µmol m-2 s-1 were essentially similar, while those exposed to 210 µmol m-2 s-1 showed higher compensating and saturating irradiances (where net photosynthesis is zero and maximal respectively), but no changes of maximum photosynthetic or respiration rates. The limited plasticity in photo-acclimation between 20 and 50 µmol m-2 s-1 suggests that these plants were fully acclimated to low light and this will constrain the conditions under which transplants to a highly turbid lake are likely to be successful.

Fluid practices: understanding adaptations to material change in everyday water use.

Julie Clarke

Waterways Centre for Freshwater Management &
Department of Environmental Management,
Faculty of Environment Society and Design, Lincoln University, Julie.abbari@canterbury.ac.nz

Everyday water-use practices such as using the toilet or washing oneself can be viewed as the configuration of a variety of different elements. These elements are material, such as technological appliances, water, consumables, infrastructure, and the body itself, as well as competences, such as skills, techniques, and know-how, and also meanings or ideas, symbols, aspirations, and emotions. The consistent and recurrent performance of these practices connects the relevant elements together. If the composite elements are changed, or the connections between them are broken, practices-as-entities may change or disappear. This conception of everyday water-use sits in direct contrast to the focus on individual responsibility which dominates policy, with attitudes, behaviour and choice being the assumed loci for strategic intervention to achieve sustainable resource use. A social practice theory approach to the study of domestic water use illuminates the inconspicuous routines that are often taken for granted, and in so doing can provide a more nuanced account of what drives resource consumption.

This study will examine adaptations to everyday water-use practices initiated by abrupt changes in the materiality of household water provision. Different kinds of change will be considered in order to capture a diversity of configurations and the elements of which they are constituted. Interviews will be conducted within four groups: earthquake-affected residents from the Eastern suburbs of Christchurch, New Zealand, who went without water or sewage infrastructure for a period of months; immigrant families who have encountered a difference in water provision and infrastructure after moving to Christchurch; Tiny Home-owners who live off-grid and unconnected to municipal utilities; and homeless people whose most private routines are conducted in public places and facilities. Climate change policies generally aim to build householders' adaptive capacity for such things as water scarcity. Therefore, an understanding of current adaptations in everyday water-use practices is important.

Flood regime changes in the Mekong River floodplain as impacted by future hydropower development

Dang Duc Thanh

Department of Civil and Natural Resources Engineering, University of Canterbury
thanhiwer@gmail.com

The Mekong River floodplain is a valuable agricultural and ecological region in South East Asia, but the catchment upstream is undergoing rapid hydropower dam development. It is projected that 135 dams with an active volume of 136 billion m^3 will be operational by 2022. The development of dams will change the river flow regime due to the regulation capacity of reservoirs, which could then influence agricultural productivity and ecosystem diversity downstream. Hence, quantification of flood regime changes in the floodplain is essential for environmental research as well as for development planning in Cambodia and Vietnam.

A hydrodynamic model was employed to understand the spatial and temporal variability of water levels in the floodplain due to the impact of different hydropower dam schemes. The simulation results show that the operation of hydropower reservoirs increase water levels in the dry season and decrease water levels in the wet season in the whole floodplain. In the upper floodplain (Cambodian Lowlands), the driest months' water levels may increase by 150% and the wettest months' water levels may decrease by 14%. In the middle of the floodplain, which is normally regulated by the 16,000 km^2 Tonle Sap Lake, the driest and wettest months' water levels changed by 250% and 8% respectively. In the lower part (the Vietnam Mekong Delta), the corresponding changes are 30% (dry months) and 12% (wet months). The influence of hydropower dams remains along the river despite shallower water depths due to the flatter topography. The Cambodian Lowlands and the Tonle Sap Lake play important roles in water level regulation for the Vietnam Mekong Delta, but the role of these natural buffer zones will diminish with greater changes in upstream flows.

Co-limitation of phytoplankton by light and nutrients in Te Waihora/Lake Ellesmere: a mesocosm bioassay study

Emma Mackenzie

Waterways Centre for Freshwater Management,
University of Canterbury,
Emma.mackenzie@pg.canterbury.ac.nz

Te Waihora/Lake Ellesmere is a shallow, eutrophic coastal lake in Canterbury. It is considered one of the most polluted lakes in New Zealand, due to high nutrient loading from its catchment, and efforts are underway to improve water quality and reduce phytoplankton development. To appropriately guide water quality management, it is essential to understand the growth response of phytoplankton. At present, the extent to which nutrients and/or rapid attenuation of light in the turbid water column control phytoplankton dynamics is uncertain. The focus of this study was to determine how light and nutrients interact to influence phytoplankton growth.

Experiments involved following phytoplankton biomass in mesocosms of varying depths in controls and after the addition of nitrate and phosphate. Early results show that nutrient addition responses can vary, with phosphate more limiting in May and nitrate in July. Light has an interactive effect with nutrient enrichment. Mesocosm depth alone did not affect biomass of natural communities, though the response to nutrient enrichment was much greater in shallow than deep mesocosms. The difference in which nutrient was most limiting at any time reflected ambient concentrations of nitrate and orthophosphate.

The emerging picture is one of complex interactions between different nutrient concentrations and light. This may render management aimed at reducing one particular nutrient ineffective, and management focused on increasing water clarity without controlling nutrients may also be ineffective or even detrimental.

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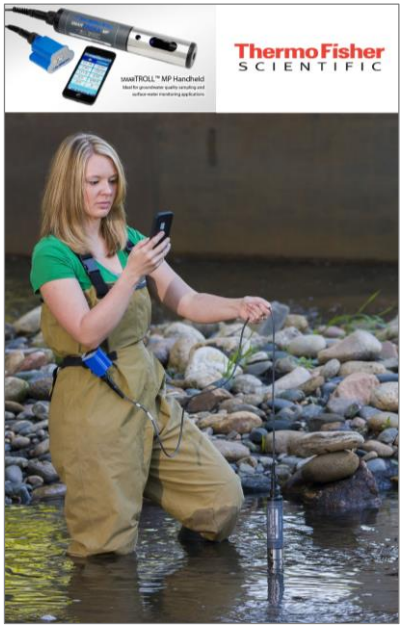

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Selwyn District Council is a Territorial Local Authority with a 2015 population of about 50,000. It is the fastest growing district in the Country and includes all the land between the Rakaia and Waimakariri Rivers back to Arthurs Pass and borders Christchurch City. Selwyn not only provide potable water (30 schemes) and Waste Water Services, (16 schemes,) but also manages 1870kms of stock water races, 9 land drainage schemes and 22 stormwater schemes.

Management of these 5 waters is undertaken within the bounds of the Canterbury Water Management Strategy and in recognition of the impact of Central Plains Water Irrigation and the multi-agency efforts to heal Lake Te Waihora.

Antarctica New Zealand is a government agency charged with carrying out New Zealand's activities in Antarctica; supporting world leading science and environmental protection. Our vision is: Antarctica and the Southern Ocean – valued, protected, and understood. We work to ensure that Antarctica's environment continues to be protected, that scientists are supported to find the answers to complex scientific questions, and that science outcomes are communicated back to policy makers and the public.

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Hill Laboratories is New Zealand's largest privately owned analytical testing laboratory, specialising in environmental, agricultural food testing. With more than 350 staff working across New Zealand, it is a significant employer of science graduates from New Zealand tertiary institutions.

The Rivers Group was formed in 2009 to provide a forum for those involved with, and with an interest in rivers, flood risk management and the operational and environmental issues of catchments and river systems. The Group incorporates a wide variety of fields, practice and interest to do with rivers, including cultural health, water quality, water quantity, flood management, energy generation and environment protection, as well as promoting a multi-disciplinary approach for river management, that reflects cultural and societal diversity in an integrated and holistic manner. Key objectives of the Rivers Group include providing a national focus for all matters relating to rivers, promoting leadership, best practice and relevant science and research, sharing of technical knowledge, facilitating cross-disciplinary discussion, promoting and sharing of technical knowledge in all aspects of catchment management, flood risk management and river engineering throughout New Zealand.

Whether you are an engineer, scientist, planner, academic, hydrologist, geomorphologist, climatologist, land manager or individual river enthusiast, membership is open to all.

Check out our website - http://www.ipenz.org.nz/riversgroup/

Notes

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