

# Waterways Postgraduate Student Conference 2017



Tuesday November 14, 2017  
Lincoln University,  
Christchurch, New Zealand



**Lincoln  
University**  
*Te Whare Wānanga o Aorangi*  
AOTEAROA • NEW ZEALAND

New Zealand's specialist land-based university



**UC**  
**UNIVERSITY OF  
CANTERBURY**  
*Te Whare Wānanga o Waitaha*  
CHRISTCHURCH NEW ZEALAND

**Waterways**  
Centre for Freshwater Management

The Organising Committee would like to acknowledge our generous sponsors:

## **Platinum**

---



## Gold

---



**Hill Laboratories**  
BETTER TESTING BETTER RESULTS

National  
**Science**  
Challenges

OUR LAND  
AND WATER

Toitū te Whenua,  
Toiora te Wai



A joint technical interest group of IPENZ & Water NZ

## Silver

---



## Bronze

---





*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 – <b>Jenny Webster-Brown</b> , Director, Waterways Centre for Freshwater Management	
9:05	Welcome – <b>Dr Rod Carr</b> , Vice Chancellor, University of Canterbury	
9:15	Virus transport through soil from on-site wastewater treatment systems	Hazel Clemens, MWRM Candidate, University of Canterbury
9:30	Improving the efficiency of stormwater treatment systems by promoting microbial growth to increase the sorption of dissolved heavy metals	Courtenay Bremner, MWRM Candidate, University of Canterbury
9:45	Inexpensive water defluoridation using calcium carbonate materials	Florjan Camlek, BSc(Hons) Candidate, University of Canterbury
10:00	Increasing the uptake of Water Sensitive Urban Design stormwater management options at the building scale in Christchurch	Vicky Southworth, MWRM Candidate, University of Canterbury
10:15	Removal of dissolved zinc and copper from roof-runoff using limestone, zeolite and mussel shell: a downpipe filtration system	Nekelia Gregoire, MWRM Candidate, Lincoln University
<b>10.30</b>	<b>Morning Tea</b>	
11:00	Understanding and quantifying contaminant discharges to Haytons Stream	Lewis Black, MSc Candidate, University of Canterbury
11:15	The fate of trace element contaminants at Tui Mine	Marlese Fairgray, PhD Candidate, University of Canterbury
11:30	Emerging organic contaminants in Canterbury shallow groundwater	Rebecca Van der Krogt, MSc Candidate, University of Canterbury
11:45	Critical review of Spatial Planning Flood Management in developing country contexts	Adam Prana, PhD Candidate, University of Canterbury
12:00	Distribution of antibiotic resistant bacteria that are human pathogens and tritagonists in waterways	Muyiwa-Emmanuel Adewale MSc Candidate, University of Canterbury

12:15	How has a disorienting dilemma transformed business owners' perception of freshwater?	Rachel Teen, MWRM Candidate, Lincoln University
<b>12.30</b>	<b>Lunch; Poster Session from 1:00 pm</b>	
1:30	Negotiating Gross National Happiness as Community Economy: a case study on Thimphu River	Sonam Pem, MWRM Candidate, University of Canterbury
1:45	Assessment of community and infrastructure lifeline vulnerability and response capacity to floods in large urban areas with limited data availability: a case study of Buenos Aires, Argentina	Yanina Ferligoj, MWRM Candidate, University of Canterbury
2:00	Composition of Canterbury mudfish food webs across a gradient of drought intensity	Christopher Meijer, MSc Candidate, University of Canterbury
2:15	Assessing Canterbury Mudfish ( <i>Neochanna burrowsius</i> ) conservation options using boosted regression trees and graph theory	Simon Coats, MGIS Candidate, University of Canterbury
2:30	The affects of vegetation, sedimentation and phosphate enrichment on freshwater macroinvertebrate diversity	Shyam Provost MAppSc Candidate, Lincoln University
<b>2:45</b>	<b>Afternoon Tea</b>	
3:15	Finding & fixing the 'leaky plumbing' to mitigate downstream nitrate export in small Canterbury agricultural drains	Brandon Goeller, PhD Candidate, University of Canterbury
3:30	Understanding factors that affect macrophytes in agricultural waterways	Katie Collins, PhD Candidate, University of Canterbury
3:45	<i>Phormidium</i> growth responses along a velocity gradient in three South Canterbury rivers	Tara McAllister, PhD Candidate, University of Canterbury
4:00	The effects of salt and light stress on the growth of <i>Stukenia pectinata</i> : Constraints on re-establishment in a degraded coastal lake	Qian Hu PhD Candidate, University of Canterbury
4:15	Development of an integrated water quality monitoring programme for Te Waihora/Lake Ellesmere	Val McMillan MWRM Candidate, Lincoln University
4:30	Identifying changes in groundwater quality and quantity resulting from border dyke to spray type irrigation conversion	Will Dench, MWRM Candidate, University of Canterbury

4:45	Methods for estimating groundwater-surface water interactions in braided rivers	Katie Coluccio, MWRM Candidate, University of Canterbury
5:00	<b>Drinks and Nibbles; Prize Presentation</b>	

Presenters and student committee members can be identified by colored 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.

## People's choice award

New to 2017 is the **People's Choice Award**! Please let us know who you think deserves to win for their outstanding oral or poster presentation. At the end of the day, simply fill in the slip of paper at the back of the book and drop it in the box at the front desk. The winner will be announced during the prize presentation.

## Posters next page

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.



## Posters

Poster Title	Presenter
Fluid practices: examining responses to disruptions in everyday water use	Julie Clarke, PhD Candidate, Lincoln University
Persistence and ecological consequences of glyphosate to control aquatic macrophytes in Canterbury lowland streams	Katie Collins, PhD Candidate, University of Canterbury
Braided rivers: Which methods have been used for investigating groundwater-surface water interactions in these complex river environments?	Katie Coluccio, MWRM Candidate, University of Canterbury
Determining aquifer characteristics from pump testing at Ilam Fields, Canterbury	Simon Demler, PMEG Candidate, University of Canterbury
Release of toxic trace elements from contaminated stream sediment at Tui Mine, Te Aroha, New Zealand	Marlese Fairgray, PhD Candidate, University of Canterbury
The effect of salinity on photosynthesis in <i>Stukenia pectinata</i> under high light and low-light stresses	Qian Hu, PhD Candidate, University of Canterbury
Hydrogeological investigation of the Christchurch City Aquifer	Logan McLean, MSc Candidate, University of Canterbury
Analysis of slug test methods for use in the highly permeable Riccarton gravel aquifer	Ben Michell, PMEG Candidate, University of Canterbury
How can Transformational Learning Theory (TLT) provide insight into business owners' perception of Water Resource Management?	Rachel Teen, MWRM Candidate, Lincoln University
Assessing seawater intrusion vulnerability associated with sea level rise in Christchurch, New Zealand, using GIS-based methods	Irene Setiawan, BAGSc(Hons) Candidate, Lincoln University
Small-scale water sensitive urban design is a critical part of future stormwater management — do you agree?	Vicky Southworth, MWRM Candidate, University of Canterbury
Eutrophication in coastal New Zealand lakes and the mitigation potential for phosphorous immobilisation using clay based amendments	Sam Whitley, BAGSci(Hons) Candidate, Lincoln University

## Introduction

---

Hello everyone. A very warm welcome to the Waterways Postgraduate Student Conference day!



This day is, without a doubt, the highlight of our year. It is an opportunity for us to showcase university research being undertaken by postgraduate students; on freshwater systems, on policies that affect water use and water environments, and on potential solutions to our freshwater management issues. For those external to our university, this day provides a rare window into research at this level, to see what is being done, and to interact and engage with those who are doing it. Conversely, it also provides our students with a valuable opportunity to engage directly with the community, iwi, industry, economic, regulatory, consultancy and research stakeholders in the freshwater resources of Canterbury and New Zealand.

The Conference day is entirely organised by a committee of 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. We would also like to thank all of those who directly support the work of the Waterways Centre, through scholarships, support for research expenses or help in-kind, and sponsorship for today. This research embodies the tangible results of your support.

By the end of the day, I trust you will share my confidence that there is room for hope regarding the future management of NZ's freshwater resources.

A handwritten signature in black ink, reading "Jenny Webster-Brown".

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

## **Tumu Whakarae - Vice-Chancellor, UC**

---

### **Dr. Rod Carr**



Prior to his appointment as vice-chancellor (Tumu Whakarae) at the University of Canterbury in February 2009, Dr Rod Carr was Managing Director of Jade Software Corporation Ltd. Dr Carr joined Jade in July 2003 after a distinguished career in the banking sector, which included holding the position of Acting Governor of the Reserve Bank of New Zealand. During a five-year career at the Reserve Bank, he played a key management role as Director and Deputy Governor, including five months as Acting Governor. Prior to this, he was a Senior Executive at the National Australia Bank in Melbourne, Australia.

Dr Carr holds a PhD in Insurance and Risk Management and an MA in Applied Economics and Managerial Science from the Wharton School, University of Pennsylvania; an MBA in Money and Financial Markets from Columbia University, New York; and undergraduate honours degrees in law and in economics from the University of Otago.

Dr Carr is a fellow of the New Zealand Institute of Management, a Director of the Canterbury Employers' Chamber of Commerce, and is a trustee of the Christchurch Earthquake Appeal Trust and the Arts Centre of Christchurch Trust Board.

## Oral Presentation Abstracts

---

### Virus transport through soil from on-site wastewater treatment systems

**Hazel Clemens, MWRM Candidate**

hazelclemens92@gmail.com



Viral pathogens present in wastewater, discharged to land from domestic wastewater systems, can contaminate groundwater and drinking water supply wells. By understanding how viral pathogens move through soils, we can optimise assessment of the risk of groundwater contamination. This is pertinent particularly in areas where drinking water supply wells are situated near wastewater discharge. Free draining soils such as those in much of Canterbury, where alluvial gravels overlie a vast groundwater resource, may increase the risk of groundwater contamination.

Current bacterial indicators do not provide a good indication of viral contamination.

This research aims to investigate the transport of pathogenic viruses in free draining Canterbury soils. Intact soil cores of loam overlying sandy gravels are used to carry out saturated and unsaturated virus transport experiments. Wastewater from domestic onsite wastewater treatment systems (spiked with the virus Rotavirus) is applied to the soil to investigate the effect of wastewater discharge on virus transport. The overall goal of this research is to improve the current data available for separation distance guidelines from on-site wastewater treatment systems to wells.

#### Research/career interests:

- Wastewater treatment
- Contaminant transport
- Drinking water quality

## Improving the efficiency of stormwater treatment systems by promoting microbial growth to increase the sorption of dissolved heavy metals

**Courtenay Bremner, MWRM Candidate**

courtenay.bremner@pg.canterbury.ac.nz



Stormwater increasingly acts as a major transport pathway for urban contaminants that accumulate on impervious surfaces because of anthropogenic activity. Urban contaminants pollute water bodies that drain stormwater and as a result, the ecological, recreational and aesthetic values of the water body are compromised. To reduce environmental impacts a range of stormwater treatment systems have been developed, which work to reduce pollutant loads entering surface and ground water systems. Furthermore, recent research has explored the use of readily abundant and recycled materials in stormwater treatment systems. These would enable

designers to utilise alternative materials for a relatively low cost and the recycling of materials would add value to the lifecycle of the material. Further improving the remedial properties of treatment systems is the presence of biofilms. Biofilms are assemblages of microbial cells connected with extracellular polymeric substances that attach themselves to moist abiotic surfaces. Their presence in treatment systems is thought to improve the removal of dissolved heavy metals from stormwater.

This research seeks to improve the removal of dissolved heavy metals in stormwater treatment systems by promoting microbial growth on alternative substrates and under differing conditions. As a whole, this research aims to contribute to the understanding of the influence of bioremediation on the assimilation of heavy metals from urban stormwater and, consequently to improve the design and operation of stormwater treatment systems.

### Research/career interests:

- Stormwater treatment/management
- Resource management
- Freshwater treatment/management
- Sustainable development

## **Inexpensive water defluoridation using calcium carbonate materials**

**Florjan Camlek, BSc(Hons) Candidate**

fca19@uclive.ac.nz



Naturally-high concentrations of fluoride in drinking water are a significant problem in parts of the Indian subcontinent, Africa, and Vanuatu. As a result, simple and inexpensive water defluoridation techniques are an active area of research. This research is expanding existing methods of acid-enhanced limestone defluoridation, by investigating the performance of novel calcium carbonate sources and edible acids. The performance of different limestone grades, crushed oyster shells, and coral sand, in conjunction with acetic, tartaric, and ascorbic acid were determined. High-surface area materials were found to be particularly effective, with fluoride concentrations in treated water in the recommended range (0.7 – 1 mg/L). Fluoride adsorption is

thought to be key to the action of these materials. The investigated methods show significant promise in terms of simplicity, affordability, and efficacy. Further work is required in adapting these methods to domestic treatment systems.

### **Research/career interest:**

- Environmental science consultancy

## Increasing the uptake of Water Sensitive Urban Design stormwater management options at the building scale in Christchurch

**Vicky Southworth, MWRM Candidate**

vicky.southworth@pg.canterbury.ac.nz



Water sensitive urban design (WSUD) uses devices and materials to reduce surface water runoff in urban environments, thereby mimicking the pre-development hydrological cycle. In addition, citizens of a water sensitive city will actively value their water, making choices that support a healthy water environment. Some WSUD researchers conclude that the use of building-scale WSUD to increase infiltration and/or re-use of rainwater close to source is essential for high quality ecological outcomes for waterways. Internationally WSUD guides prioritise at source management. Christchurch is still the site of significant development and further densification which provides an opportunity to develop in a more water sensitive way.

This research will identify the barriers to increasing the use of WSUD devices and materials at the building scale in Christchurch. Is it simply cost and lack of knowledge? Research from Melbourne and other cities, where a concerted effort to incorporate WSUD at all scales has been underway for several decades, suggests that many more barriers may be at play. Interviews with local decision makers and stakeholders such as architects, developers, planners, engineers, home owners and community groups have now begun and will provide insights into WSUD uptake here in Christchurch. Subsequently, a review of policies and interventions from around the world where sustainable stormwater management has gained momentum, informed by interview findings, will enable recommendations to be made to support a transition to a water sensitive Christchurch.

### **Research/ career interests:**

- Policy development
- Transition to a more sustainable world
- Construction projects' master planning, design and management

## Removal of dissolved zinc and copper from roof-runoff using limestone, zeolite and mussel shell: a downpipe filtration system

**Nekelia Gregoire, MWRM Candidate**

nekelia.gregoire@lincolnnuni.ac.nz



The dissolved form of zinc (Zn) and copper (Cu) found in urban stormwater and waterways have been of particular concern in major cities worldwide, including in New Zealand, due to their toxic effects on aquatic organisms. In New Zealand, galvanized and copper roofs contribute the highest per area dissolved Zn and Cu concentrations respectively to urban stormwater. Current stormwater management strategies have mostly focused on physical removal processes for particulate contaminants and therefore, the ecotoxic dissolved contaminants tend to pass through largely untreated. Coupled with the large number of existing Zn and Cu-based roofs, there is a need to develop new technologies that can remove these dissolved metals.

This research explores the use of zeolite, limestone and mussel shell as filter materials in a source control filter system that can be installed in a downpipe for the removal of dissolved metals from roof-runoff. Benchtop experiments were conducted to assess the hydraulic conductivity and potential metals-removal rates of limestone, mussel shell and zeolite. The effect of water retention time on removal rates was also explored. Lab-scale filter system trials were conducted to evaluate the effect of varying flow rates on metal removal. The performance of each media will then be evaluated under field conditions to assess the influence of natural variability in runoff quality and quantity. The results will inform the design of a filtration system that can be installed in downpipes of new or existing buildings for removing dissolved heavy metals from roof-runoff to reduce their contribution of ecotoxic metals into urban waterways.

### Research/career interests:

- Freshwater and stormwater management
- Agricultural consultancy



## Understanding and quantifying contaminant discharges to Haytons Stream

### Lewis Black, MSc Candidate

lewis.black@pg.canterbury.ac.nz



Haytons Stream, a headwater tributary of the Heathcote River/Ōpāwaho, is consistently ranked with the worst water quality of the 44 annually monitored city waterways by the Christchurch City Council. Past investigations have highlighted that the stream is polluted with heavy metals, ammoniacal-nitrogen and Dissolved Reactive Phosphorous. Preliminary monitoring evidence suggested point-source discharges entering the stream may be major contributors to poor water quality as well as historically contaminated bed sediment. The aim of this research was to determine the spatial and

temporal distribution of contaminants within and entering Haytons Stream.

Baseflow, stormflow, and bed sediment sampling was conducted at select locations in the Haytons Stream catchment. Additionally, continuous in-field data logging of water level and conductivity was done at 5 key locations, to compare with rainfall data and identify where point-source discharges may be entering the stream.

Initial results show that the Haytons Stream bed sediment is significantly contaminated, particularly with zinc, and is likely leaching metals to the water column as shown through 'bioavailability' extractions. Continuous data logging has detected regular occurrences of point-source discharges in the catchment, represented through fluctuations in stream water level independent of rainfall.

Implications of this research include increased knowledge for industrial pollution prevention, more efficient stormwater and site-specific management, and further validation for the use of data loggers to identify non-stormwater (point-source discharge) entries to stormwater networks and surface waterbodies.

### Research/career interests:

- Freshwater quality
- Environmental contaminant tracking
- Contaminated land

## The fate of trace element contaminants at Tui Mine

### Marlese Fairgray, PhD Candidate

marlese.fairgray@pg.canterbury.ac.nz



At Tui Mine, trace elements such as copper, lead, zinc, cadmium, iron, and manganese are present in the solutions draining from the mine adits and tailings dam in extremely high concentrations. This has caused the aquatic ecosystem downstream of the mine to become degraded.

Investigations into the fate of trace element contaminants were carried out in order to establish which solid phases the trace elements are adhering to and how this affects their toxicity to aquatic biota. Investigative methods such as sequential chemical extraction (SCE) of elements from specific mineral phases, scanning electron microscope (SEM) and geochemical modelling were employed to ascertain which solid phase are binding contaminants. It was verified by SEM that trace elements were binding to iron oxide minerals with minor binding to manganese oxide minerals. This was a contradiction to what had been determined by SCE but had been predicted by geochemical modelling. Leaching experiments using bed sediment showed that desorption of trace elements from sedimentary iron and manganese oxides can occur but would not be impacting on water quality further downstream at this present time given the current concentrations in the mine drainage solution.

#### Research/career interests:

- Acid mine drainage
- Metal contaminants
- Rehabilitation
- Geochemical modelling

## Emerging organic contaminants in Canterbury shallow groundwater

**Rebecca Van der Krogt, MSc Candidate**

rebecca.vanderkrogt@pg.canterbury.ac.nz



There is increasing concern regarding contamination of groundwater by emerging organic contaminants. Groundwater contamination can occur through the irrigation of wastewater to land, application of biosolids, waste disposal, leakage from septic tanks and sewer systems, and urban and rural stormwater run-off. The purpose of this study is to evaluate the presence of a suite of EOCs in treated effluent, soil, and groundwater. Limited research has been conducted in New Zealand investigating the presence of EOCs in the environment and this study will be the first of its kind to investigate the presence of EOCs in groundwater. This study is taking place across the Canterbury region. Groundwater has been sampled from 18

shallow wells across Canterbury and analysed for a suite of EOCs, dissolved organic carbon and in-situ parameters. The suite of EOCs includes hormones, industrial chemicals, preservatives, ultra-violet filters and anti-microbial compounds. Analytes detected to date include methyl paraben, ethyl paraben, o-phenylphenol, 4-tert-Octylphenol, Propyl paraben, Butyl paraben, Chlorophene, 4 - methylbenzylidene camphor, Benzophenone-3, Bisphenol A, 2-ethylhexyl-p-methoxycinnamate and Estriol ranging from 1.1 to 388 ng L<sup>-1</sup>. There is a relationship between the detected analytes and their calculated groundwater ubiquity scores with the detected analytes having higher leaching potentials. The implications of this first survey of EOCs in groundwater will be discussed.

### Research/career interests:

- Environmental science
- Hydrogeology

## Critical review of spatial planning flood management in developing country context

**Adam Prana, PhD Candidate**

adam.prana@pg.canterbury.ac.nz



A spatial approach to water management, especially in the case of flood management, continues to change. The change in approach takes place along with a growing understanding that if floods can be adapted and accommodated properly then flooding is not always damaging and may even provide benefits. The process of spatial planning and space utilization also continues to experience improvements related to it and has been studied in some literature, especially by research that comes from developed countries. Cities in developing countries like Jakarta with rapid population growth and low economic levels that have a large number of slum housing will be more difficult to apply the theory of flood adaptive spatial planning. The application of the theory of spatial planning

flood management will be more difficult in Jakarta because most theories of the developed world are created with the assumption of more established economic conditions and more orderly social conditions. This presentation discusses the possibility of implementing a refinement of spatial planning flood management approach in developing countries by reviewing literature and policy analysis in Jakarta. The paper concludes that spatial planning is not effectively used in Jakarta for flood management due to the incomplete operational regulations especially in terms of new and evolved concepts.

### Research/career interests:

- Flood management
- Spatial planning
- Landscape architecture
- Urban design

## Distribution of antibiotic resistant bacteria that are human pathogens and tritagonists in waterways

**Muyiwa-Emmanuel Adewale, MSc Candidate**

muyi105@yahoo.co.uk



Could freshwater ecosystems be reservoirs of antibiotic resistant bacteria? Non-antibiotic chemicals used in both farming and urban areas may contribute to resistance. Some studies have shown that rivers draining agricultural and urban areas carry greater burdens of antibiotic-resistant *Escherichia coli* than do rivers in unpolluted environments. We are testing the hypothesis that anthropogenic activities may influence or speed up the emergence of antibiotic resistant bacteria.

I have measured the number and diversity of antibiotic resistant *E. coli* in two Canterbury rivers. One river is dominated by agriculture, Silver Stream (Whirinaki) and the other by urbanization (Avon River) land use. The rivers have been sampled three times between January 2017 and October 2017. *E. coli* isolates were enumerated on TBX medium with and without supplementation with ciprofloxacin, ampicillin, rifampicin or chloramphenicol. Overall, 60 % of the *E. coli* isolates from the Avon River grew on ampicillin at (10 µg/ml), 10% on chloramphenicol at (6 µg/ml) and 10 % on ciprofloxacin at (1 µg/ml). The MIC of 60% of the *E. coli* initially isolated from the Avon River on 1 µg/ml ciprofloxacin was almost 5 times higher than the clinical breakpoint.

Nearly 70% of *E. coli* isolates from the Avon River were resistant to 2 or more antibiotics. Of the ciprofloxacin-resistant isolates, 98% also grew on ampicillin, 33 % on chloramphenicol, 88 % on tetracycline, 54 % on trimethoprim, 37 % on gentamycin and 19 % on kanamycin. In contrast, 30 % of Silver Stream isolates were resistant to at least 2 antibiotics. Fewer than 1 % were resistant to ciprofloxacin or chloramphenicol. The survey results suggest that the two rivers have different potentials to accumulate particular antibiotic resistant *E. coli*. This research demonstrated the prevalence and distribution of antibiotic resistance in the environment. What caused the resistance, or retention of resistant bacteria, is not known. Such factors will be critical to identify for long term sustainability of antibiotic efficacy.

### Research/career interests:

- Environmental microbiology and public health
- Medical microbiology
- Molecular biology

## How has a disorienting dilemma transformed business owners' perception of freshwater?

### Rachel Teen, MWRM Candidate

rachelteen@icloud.com



Transformational Learning Theory (TLT) is the lens this study uses to ascertain how and if Havelock North's 2016 freshwater resource contamination altered business owners' perception of water. Transformational Learning Theory asserts that a major disruption to people's worldviews can trigger a series of critical reflections that can lead to a transformation in thinking, perceptions, and actions.

My research focuses on micro, small and medium enterprise (MSME) owners in Havelock North and whether the campylobacter outbreak there triggered a 'disorienting dilemma' and subsequently an altered perception of water.

Many MSME owners believe their individual operations are so small and 'below the radar' that they deem their water use as insignificant. In general, they do not yet recognise the cumulative effect their ~450,000 New Zealand MSME's have on our water resource.

This study aims to reduce the vacuum of knowledge regarding MSME owners' environmental perceptions, action, and behaviours and increase our understanding of water resource management amongst MSME's for future effective policy making.

#### Research/career interests:

- Hydro-social cycle
- Urban contamination
- Sustainable policy-making
- Transformational learning
- Disruptive innovation

## Negotiating Gross National Happiness as Community Economy: a case study on Thimphu River

**Sonam Pem, MWRM Candidate**

spe78@uclive.ac.nz



Bhutan has been facing the challenges of climate change like many other developing countries while in the process of development. With many economic development activities, individuals and communities have overlooked the impact on water use and the management of urban waterways. This has led to the deterioration of urban waterways. Thimphu River today has been ignored and at the same time exploited by many users living in and around the vicinity. This has challenged the values of Gross National Happiness (GNH), the development philosophy of Bhutan, which protects the values of respecting each other as human as well as values

for non-human, interpreting nature as a living ecosystem rather than resource base or commodity that is there to be exploited for material gain. One of the principles of GNH states that happiness is deeply connected to people's relationship with a healthy, vibrant and wholesome natural environment. However, it has been challenging for Bhutan to have a balance between economic developments and meet socio-ecological goals.

I have used the concepts of “diverse economy” correlating with GNH to explore the relationship between Thimphu River and the wellbeing of the people in the communities around it. Through this study, I have examined the challenges faced by the human and the non-human factors (i.e. Thimphu River) and exploring the disconnection between the policy and the ground reality and also between people and the nature.

This research was carried out by understanding the perceptions and attitudes of the community towards Thimphu River through interviews, focus group discussion, visual methods and group activities.

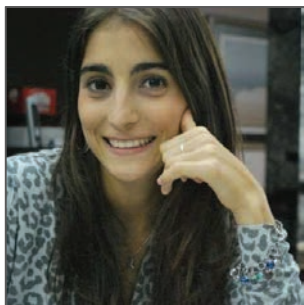
### **Research/career interest:**

- Fresh water management through community approaches.

## Assessment of community and infrastructure lifeline vulnerability and response capacity to floods in large urban areas with limited data availability: a case study of Buenos Aires, Argentina

**Yanina Ferligoj, MWRM Candidate**

yfe29@uclive.ac.nz



The determination of infrastructure lifeline vulnerability and response to flooding is a significant aspect of hazard management. The availability of information defines how detailed vulnerability assessments can be and how can they inform decision-making processes. Flood risk areas in Buenos Aires, Argentina have been identified geographically. However, the relationship between flood risk, vulnerability, potential damage and the city's response capacity has not been analysed deeply.

Therefore, this study aims to: determine the extent of community and infrastructure lifeline vulnerability to flooding with limited information available; and propose appropriate flood mitigation measures for current conditions and projected flood impacts resulting from sea-level rise over the 21<sup>st</sup> century.

These objectives will be achieved by a flood vulnerability assessment in ArcGIS software, using geographic data, depth-damage curves and a flood model that considers the effects of climate change. The vulnerability assessment includes quantification of flood damage in various scenarios of different return periods, and includes the following aspects:

- Structural and contents damage to residential, industrial and commercial properties;
- Damage to infrastructure lifelines (e.g. road and electricity networks), and critical facilities (e.g. hospitals and electricity substations).

The response capacity of the city is also evaluated. The proximity of flood-prone areas to key infrastructure is studied to identify which sites can offer assistance or where emergency response agencies can set up monitoring points. This study will provide preliminary damage assessment estimates and identify potential improvements for emergency response plans.

### Research/career interests:

- Water resources management
- Risk management and resilience
- Geographic information systems



## Composition of Canterbury mudfish food webs across a gradient of drought intensity

**Christopher Meijer, MSc Candidate**

christopher.meijer@pg.canterbury.ac.nz



Stress-tolerant species that reside in extreme conditions outside the niche of competitors and predators are likely to be particularly vulnerable to global environmental change. The nationally critical Canterbury mudfish (*Neochanna burrowsius*) is such a species that persists only in isolated waterbodies on the Canterbury Plains which allow them to avoid predators. However, these habitats are often subject to harsh environmental conditions, such as extreme habitat drying. Sites, identified as either an isolated pool or 20 m reach, were selected within the Waianiwaniwa Valley and along the Hororata River and, using stable isotope analysis with support from gut content analysis, site-specific food webs were constructed. Using variation in pool depth as a proxy for drought intensity, we investigated the likely impact of changing drought regimes on the food webs of mudfish-inhabited waterways. Future directions involve comparing these food webs with those constructed for brown mudfish (*Neochanna apoda*), a closely-related and ecologically similar species, because some brown mudfish reside within native swamp forest. This study could potentially provide insight into the likely food webs of historic Canterbury mudfish populations.

### Research/career interests:

- Drought-induced changes in aquatic food webs
- Translocations of endangered fishes

## Assessing Canterbury Mudfish (*Neochanna burrowsius*) conservation options using boosted regression trees and graph theory

Simon Coats, MGIS Candidate

simon.coats@pg.canterbury.ac.nz



With habitat degradation and introduced species continuing to threaten freshwater biodiversity around the world, there is an increasing need to embrace innovations in spatial modelling to improve conservation outcomes. This need is well illustrated by Canterbury mudfish (*Neochanna burrowsius*), a critically endangered fish that has been largely unresponsive to past conservation efforts. To better understand the spatial opportunities for Canterbury mudfish conservation, we used geographic information systems (GIS) and a machine-learning statistical technique to predict and map potential mudfish habitat. Seven variables important for mudfish occurrence were analysed with boosted regression trees and used to map habitat suitability. Habitat suitability was

effectively modelled (Area Under Curve = 0.80) with just three variables: predator/competitor absence, mean annual low flows, and low velocity flow classes. Mapping suitable habitat revealed it was highly fragmented across the Canterbury Plains, and included many areas currently inaccessible to mudfish. The percentage of deviance in mudfish occurrence explained was low (23.8%), indicating that local complexities not captured by landscape-scale analyses further control mudfish occurrence. Nevertheless, our landscape model allows suitable habitat to be quickly identified and prioritised. We're now creating a local-scale, GIS-based graphical model, to predict which alterations to the spatial configuration of mudfish habitats, including translocations, could provide the greatest conservation benefits. Overall, this evaluation of mudfish distribution indicates how spatial modelling techniques can be rapidly applied to address urgent threats faced by freshwater biodiversity.

### Research/career interests:

- Spatial modelling
- Biogeography

## **The affects of vegetation, sedimentation and phosphate enrichment on freshwater macroinvertebrate diversity**

### **Shyam Provost, MAppSc Candidate**

Shyam.Provost@Lincolnuni.ac.nz



This Masters research project focuses on the waterways of Mt. Grand, a South Island high country station. The station is 2136 ha of mountainous terrain, running fine wool Merino sheep and a small herd of beef cattle.

Nearby, flatter land has undergone agricultural intensification, and several higher altitude areas of the station have been converted for public conservation. Situated between these conversions, Mt. Grand Station faces intensified agronomic pressures to remain economically viable, which may affect the ecological quality of its waterways. The objective of this research is to monitor phosphate enrichment and sedimentation (variables closely associated with land-use

intensification) levels of Mt Grand's waterways, and how these variables affect benthic macroinvertebrate habitat.

Three streams in differing catchments were studied. Streams were sampled for phosphate enrichment, visual clarity, total suspended solids, and various other physiochemical parameters. Macroinvertebrate communities were also sampled, providing useful inferences on the ecological health of each sample site.

Results show that phosphate enrichment was highest in the catchment containing the least vegetation, no conservation area, and increased agricultural land-use. This catchment recorded the lowest macroinvertebrate community index scores and the lowest percentages of observed pollution intolerant taxa. The combined results from all three catchments show a negative relationship between the observed percentages of sensitive macroinvertebrate taxa and phosphate enrichment. This research will enable station management to make better-informed decisions involving the freshwater resources of Mt. Grand.

### **Research/career interests:**

- Freshwater Biodiversity/Management
- Soil Management
- Sustainable Farming
- Resource Management
- Restoration

## Finding & fixing the 'leaky plumbing' to mitigate downstream nitrate export in small Canterbury agricultural drains

**Brandon Goeller, PhD Candidate**

brandon.goeller@pg.canterbury.ac.nz



A vast network of surface and subsurface drains support agricultural production on the Canterbury Plains. However, these drains can act as 'leaky plumbing' by transporting leached soil nitrate and nitrate from shallow groundwater/springs downstream, circumventing riparian protection networks. Within the Canterbury Waterway Rehabilitation Experiment (CAREX), we quantified nitrate export in 9 one-kilometre long lowland agricultural headwaters <2 m wide to characterise local vs. regional influences on leaky plumbing. We measured nitrate concentrations and discharge at least monthly for 4 years to estimate annual mass loads (kg) and to characterize 'hot moments' and 'hotspots' of nitrate export. Across-site differences in upstream/spring water nitrate concentrations generally predicted differences in annual

nitrate loads at catchment outlets (range <1 – >50 tonnes  $\text{NO}_3\text{-N}$  per water year), and nitrate loads were higher in wet seasons (autumn and winter) and wet years, all reflecting strong groundwater influences. However, nitrate export from tile drains was more variable and sometimes substantial when compared to catchment export. Moreover, fluctuations in nitrate export from tile drains were much more strongly tied to changes in tile drain discharge and less associated with groundwater influences. Thus, tile drains are very likely local 'hotspots' of nitrate input. Characterising the timing and contributions of regional groundwater/springs versus leached soil nitrates from tile drains has helped identify the scales and locations for nitrate mitigation tools to fix the 'leaky plumbing' in small Canterbury agricultural waterways.

### Research/career interests:

- Stream ecosystem ecology & rehabilitation
- Biological monitoring
- Environmental policy

## Understanding factors that affect macrophytes in agricultural waterways

**Katie Collins, PhD Candidate**

katie.collins@pg.canterbury.ac.nz



As part of the Canterbury Waterway Rehabilitation Experiment (CAREX), we conducted a large spatial scale survey to identify environmental factors that influence macrophyte growth. Aquatic macrophytes provide important functions in stream ecosystems, however, excessive macrophyte growth in agricultural landscapes can have negative impacts including accumulating sediment and causing flooding. When agricultural waterways become choked during summer, management typically involves mechanical clearance using a bank-side digger. This practice can over steepen banks, damage in-stream habitat and hinder aquatic ecosystem function. We surveyed 28 small waterways (<5m wetted width) across the Canterbury region, measuring reach and small scale site factors that might influence macrophyte species present and percentage macrophyte cover. Understanding the different factors influencing macrophyte distribution and growth and the scale at which they operate will be useful in terms of developing management strategies for addressing excessive macrophyte growth in Canterbury.

### Research/career interests:

- Aquatic macrophytes
- Land-use effects on streams
- Stream rehabilitation
- Agricultural waterways

## ***Phormidium* growth responses along a velocity gradient in three South Canterbury rivers**

**Tara McAllister, PhD Candidate**

tara.mcallister0@gmail.com



Toxic benthic cyanobacterial proliferations, of the genus *Phormidium*, are an escalating problem in freshwater environments worldwide. In NZ there has been an increase in the distribution, intensity, and frequency of *Phormidium* blooms in recent decades. To date, understanding what conditions favour bloom formation has been dependent on observational studies, which have associated a range of environmental factors, including nutrients and flow, as potentially important in facilitating *Phormidium* accrual. However, few of these studies are undertaken with sufficient spatial or temporal

resolution to provide explicit information on relationships between *Phormidium* accrual dynamics and environmental conditions. To overcome this we have developed a method that allows us to accurately assess *Phormidium* accrual rates by seeding cobbles with a known quantity of *Phormidium*.

In this study, 135 cobbles seeded with *Phormidium* were placed in pools, runs, and riffles in three different rivers with varying nitrate concentrations. Biomass and growth rates were measured over four weeks. Water nutrient chemistry and macroinvertebrate communities in each habitat type were also determined. Initial analysis of results show that patches in pools were removed quickly due to high grazing pressure and that patches expanded most rapidly at intermediate velocities. However, growth rates also varied among rivers, with highest growth rates measured in the Ōpihi River, which had intermediate nutrient concentrations. The study highlights that velocity, site-specific factors, and grazers interact in complex ways in influencing *Phormidium* accrual dynamics.

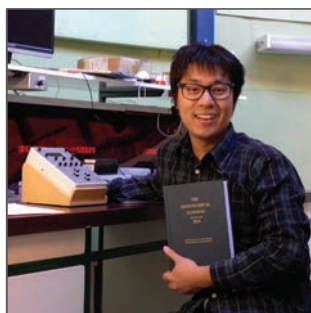
### **Research/career interests:**

- Freshwater ecology
- Mātauranga Māori

## The effects of salt and light stress on the growth of *Stukenia pectinata*: Constraints on re-establishment in a degraded coastal lake

**Qian Hu, PhD Candidate**

qian.hu@pg.canterbury.ac.nz



Lake Ellesmere is a shallow coastal lagoon located on the east of the South Island of New Zealand and is periodically open to the sea. An extensive macrophyte bed once existed around the lake margins, which disappeared after a storm event in 1968, and never returned. Now the lake is highly turbid with a light attenuation coefficient of  $\sim 10^{-m}$  and has fluctuating salinity varying from 3 to 21 ppt. Understanding how an indigenous macrophyte, *Stukenia pectinata*, responds to light and salinity stress is of critical importance for attempts to manage re-establishment of a macrophyte bed.

Experiments demonstrated that when low light stressed, *S. pectinata* etiolates to reach the better-illuminated upper water column sooner, and that leaves have a higher chlorophyll per dry weight and increased efficiency in utilizing low light, substantiated by significant increases in apparent quantum yield at low irradiance in leaf photosynthesis-irradiance curve analysis. A leaf compensation irradiance of  $10 \mu\text{mol photons m}^{-2} \text{ s}^{-1}$  for shade adapted leaves was estimated, meaning that plants need to reach the upper 30 - 40 cm of the water column using belowground reserves. Once established, surface reaching shoots replenish belowground reserves rather than support new shoots directly. Salinity stress compounds the light stress: high salinity triggers early leaf senescence, with the proportion of dead leaves positively correlated with salinity over time, thus reducing plant size and irradiance harvesting. Plants did not tolerate salinities exceeding 20 ppt. Leaf dry weight to fresh weight ratio increased with salinity stress up to 18 ppt, and while chlorophyll per dry weight was not affected by salinity, maximum photosynthetic rate standardized to chlorophyll-a was reduced by salinity for leaves in high light but not in low light.

## Development of an integrated water quality monitoring programme for Te Waihora/Lake Ellesmere

**Val McMillan, MWRM Candidate**

mcmillanvm@gmail.com



Monitoring is essential to the management of many environmental activities. Unless we monitor progress, and react according to the results, management may not be optimal. Monitoring allows for more informed decisions and wiser management.

Te Waihora/Lake Ellesmere has a special place in the economy, culture, and environment of Canterbury. As an ICOLL (intermittently opened and closed lake or lagoon), it has its own unique set of 'issues' and challenges but like all shallow coastal lakes, it is affected by the historic and current land use in the catchment it serves. The Selwyn catchment is intensively developed and there are a large number of stakeholders with an interest in the lake and its future quality.

This research aims to design an over-arching robust monitoring programme with the specific objective of identifying key water quality changes over time. The monitoring programme builds on existing programmes undertaken by different stakeholder groups; addresses possible gaps and recommends ways to address these.

### **Research/career interest:**

- Water quality in Canterbury



## Identifying changes in groundwater quality and quantity resulting from border dyke to spray type irrigation conversion

### Will Dench, MWRM Candidate

william.dench@pg.canterbury.ac.nz



The Hinds Rangitata Plain (HRP) is located on the Canterbury Plains and bound by the Rangitata and Hinds Rivers, Southern Alps foothills and the Pacific Ocean. Irrigated agriculture on the HRP started in 1947 with the completion of the Mayfield Hinds Irrigation Scheme (MHIS). The Rangitata River supplies freshwater to the MHIS from the Rangitata Diversion Race (RDR). The MHIS operates today as a farmer owned co-operative, delivering water to more than 33,000 hectares of highly productive land.

Irrigation practices on the HRP have changed in the past decade from primarily border dyke irrigation to spray irrigation. Border dyke irrigation, a type of flood irrigation method, provides greater quantities than the soil can hold and results in large amounts of irrigation water recharging the underlying groundwater. Spray irrigation applies water at a uniform rate and results in a reduced loss of irrigation water to groundwater, compared to border-dyke irrigation. The reduced groundwater recharge associated with conversion to spray-type irrigation is thought to have considerable impacts on HRP groundwater resources. These impacts include declining groundwater levels, drying of shallow wells and a reduction of baseline flow in coastal spring-fed waterways.

Continuous declines in groundwater quantity and quality over the past decade in the HRP pose a serious risk to drinking water sources and waterways ecology. The aim of the current project is to improve understanding of the change in groundwater hydrology in the HRP following conversion from border dyke to spray irrigation.

#### Research/career interests:

- Groundwater quality
- Groundwater modelling
- Stable isotopes as tracers
- Managed aquifer recharge

## Comparison of methods for measuring groundwater-surface water interactions in braided rivers

**Katie Coluccio, MWRM Candidate**

katie.coluccio@pg.canterbury.ac.nz



Braided rivers are often highly connected to groundwater systems, with water flowing between the two systems. Rivers can gain surface flow from groundwater and likewise lose flow to subsurface groundwater systems. Understanding the interactions between groundwater and surface water systems has important implications for water resource management including sustainable allocation of water use, contaminant transport, and ecological purposes. Braided rivers present several challenges for measuring groundwater-surface water exchange including their

highly permeable gravel beds, flashy flood flows, heterogeneous make-up of streambeds and meandering channels. While there have been many field studies of groundwater-surface water interactions in other types of water bodies, there is a gap in the literature with respect to braided river environments.

This study compares the effectiveness of several field methods for measuring groundwater-surface water interaction in the South Branch of the Ashburton River in Canterbury. Several techniques have been trialled including the installation of mini-piezometers and vertical temperature probes, differential flow gauging and tracer measurements. These field methods have been used to characterise and quantify seepage rates.

The Ashburton River and surrounding groundwater are highly allocated for agricultural use, and gaining a better understanding of gains and losses to the system, as well as identifying appropriate tools to carry out these investigations, will contribute to the knowledge base for effective water management in the Ashburton area. More generally, this study seeks to enhance the toolbox for investigations of groundwater-surface water exchange in braided rivers.

### Research/career interests:

- Water quality and quantity
- Water policy
- Science communication

## Poster Abstracts

Poster Session from 1.00pm to 1.30pm in the foyer

---

### Fluid Practices: examining responses to disruptions in everyday water use

**Julie Clarke, PhD Candidate**

julie.clarke@lincoln.ac.nz



Policies aimed at encouraging water conservation are often framed in terms of individual responsibility, constructing the public as consumers who will respond rationally to such things as economic instruments, education campaigns, and smart meters. In contrast, Social Practice Theory views everyday water-using routines as *social practices*, configurations of materials, competences, and meanings that extend beyond individuals to the technologies, infrastructure, policies, social norms and cultures they are embedded in.

My study examines everyday water use practices affected by changes in water provision to explore the ways in which Social Practice Theory might illuminate what drives our resource use. Different kinds of change are considered in order to capture a diversity of configurations and the elements of which they are constituted. Interviews are conducted with four groups: earthquake-affected residents from Christchurch, New Zealand; immigrants who have encountered a difference in water provision after moving to Christchurch; people who live off-grid and unconnected to municipal utilities; and visitors to Antarctic bases where water provision is an energy-intensive process.

Examining everyday water use practices can demonstrate the utility of Social Practice Theory in informing water resource policy.

#### Research/career interests:

- Social and cultural issues in water resource management
- Social change
- Social justice
- Socio-environmental relations.

## Persistence and ecological consequences of glyphosate to control aquatic macrophytes in Canterbury lowland streams

**Katie Collins, PhD Candidate**

katie.collins@pg.canterbury.ac.nz



Public interest in the use of glyphosate to control aquatic macrophytes in the Canterbury region is high. As part of the Canterbury Waterway Rehabilitation Experiment (CAREX), we worked with the Waimakariri District Council to monitor the impact of macrophyte spraying on a sub-set of the District's lowland spring fed drains. Five small waterways 200m reaches were sprayed with glyphosate in December 2016. Upstream of each treated reach a 200m control reach was left unsprayed. Stream water and bed sediment samples were collected in both the control and

treatment reaches pre spraying, the day of spraying, the day after spraying, and 5-days, 3-weeks, 6-weeks and 14-weeks after spraying. Aquatic invertebrate and fish surveys were also undertaken. Initial results indicate glyphosate degrades quickly in the water column, but persists for weeks in the sediment.

### Research/career interests:

- Aquatic macrophytes
- Land-use effects on streams
- Stream rehabilitation
- Agricultural waterways

## **Braided rivers: Which methods have been used for investigating groundwater-surface water interactions in these complex river environments?**

**Katie Coluccio, MWRM Candidate**

katie.coluccio@pg.canterbury.ac.nz



This research involved a review of the literature on investigations of groundwater-surface water exchange in braided rivers. The various methods used to characterise these processes were reviewed, with particular emphasis on effectiveness in achieving the studies' objectives and their applicability in braided river environments.

Braided rivers are highly valued water resources for various economic, cultural, recreational and ecological purposes. However, they are complex and dynamic systems, which can make it difficult to manage them effectively. One aspect that complicates the understanding of braided rivers relates to groundwater and surface water interactions. Braided rivers are characterised by multiple meandering channels that deposit gravel bars and islands, which generally create a highly porous and interconnected environment for groundwater and surface water to mix. Many of these rivers have reaches that gain flow from groundwater or lose surface water to sub-surface aquifers.

There is an increasing recognition of the importance of understanding how groundwater and surface water interact for applications such as determining the rate and direction of contaminant flow and identifying sustainable volumes of water that can be abstracted from aquifers and surface water bodies. Until recently, groundwater and surface water systems were often considered separately both in research and in their management as freshwater resources. However, in the past few decades, there has been a considerable increase in research focusing on groundwater and surface water interactions.

### **Research/career interests:**

- Water quality and quantity
- Water policy
- Science communication

## Determining aquifer characteristics from pump testing at Ilam Fields, Canterbury

**Simon Demler, PMEG Candidate**

sfdemler@gmail.com



Pump testing in a well is a critical element for assessing the behaviour of an aquifer and its key properties. Properties such as hydraulic conductivity, transmissivity, and storativity are used for aquifer characterisation, assessing groundwater flow characteristics and understanding the hydraulic connection of wells to proximal springs. Following on from Moore's study in 1986 which looked at determining some of these key properties, a pumping test will be carried out in irrigation well M35/5557 at Ilam Fields, University of Canterbury. Moore's test did not account for fluctuations in barometric pressure because of a lack of availability of technology at the time. This issue can be accounted for using pressure transducer water loggers available today.

Among the several analytical techniques that exist for calculating these properties, the Hantush-Jacob method has been chosen due to the fact that it accounts for a partially penetrating well while others do not, which is a crucial consideration for the well being studied. From measuring the drawdown during the pumping test and then applying this method, the hydraulic conductivity can be determined and an indication of the hydraulic connection between the Riccarton Gravels aquifer and the Ōtākaro-Avon stream at Ilam Fields can be inferred.

### Research/career interests:

- Engineering geology and hydrogeology
- Rock mechanics

## Release of toxic trace elements from contaminated stream sediment at Tui Mine, Te Aroha, New Zealand

**Marlese Fairgray, PhD Candidate**

marlese.fairgray@pg.canterbury.ac.nz



At the Tui Mine, mine drainage water from the tailings dam and adits was discharged into local waterways during the operation, and following closure of the mine. Consequently, iron and manganese (oxy)hydroxides with adsorbed toxic trace elements have formed in and on the stream bed sediments. Remediation of the mine site has reduced contaminant discharge into the streams, but the legacy of contaminated stream sediment may hinder the restoration of a healthy stream ecosystem. Currently, sediment in the streams contains trace element concentrations well in excess of guideline values for sediment quality. In order to determine a realistic timeline for ecosystem restoration downstream of the Tui Mine, an estimate of the rate at which contaminated sediment will release adsorbed toxic trace elements is required. Batch leaching experiments of sediments from Tunakohioia Stream, which receives discharge from the mine adits, and Tui Stream, which receives discharge from the tailings dam, have been undertaken. Results showed that copper and arsenic were relatively rapidly leached for sediments, attaining equilibrium within 24 hours. However, the equilibrium dissolved metal concentrations were very low, and unlikely to significantly change water or sediment quality. Slower leaching of iron, lead, manganese, zinc and cadmium was observed, again with low dissolved metal concentrations, even after 10 days. We conclude therefore that sediment contamination may be a long term obstacle to re-establishing a healthy stream (benthic) ecosystem, but that ongoing sediment leaching is unlikely to significantly degrade water quality.

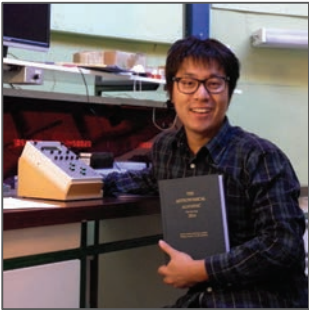
### Research/career interests:

- Acid mine drainage
- Streams
- Heavy metals
- Adsorption, desorption, and kinetics
- Hydrological models

## The effect of salinity on photosynthesis in *Stukenia pectinata* under high light and low-light stresses

**Qian Hu, PhD Candidate**

qian.hu@pg.canterbury.ac.nz



The growth of submerged macrophytes (*Stukenia pectinata*) in Te Waihora (Lake Ellesmere) is affected by light and fluctuating salinities. Tracking the relationship between light and salinity's impact on photosynthesis provides insights on suitable conditions for re-establishment of macrophyte beds. In the highly turbid water column, leaves of *Stukenia Pectinata* experience light field changes by orders of magnitude-- from 2000  $\mu\text{mol}/\text{m}^2/\text{s}$  on the water surface attenuating to near darkness at 40 cm deep. Based on the photosynthesis - irradiance curves (PI curves) of *S. pectinata* in the lake, 2000  $\mu\text{mol}/\text{m}^2/\text{s}$  is far beyond the required the light

intensity for maximum photosynthesis. On top of the light stresses, salinity likely affects the plant synergistically as external environmental stresses translate into over-excitation pressure on the photosystem.

To understand this further, salt stressed plants, versus freshwater plants as a control, were tested under three light conditions: 350, 110, and 50  $\mu\text{mol}/\text{m}^2/\text{s}$ : high light (HL), medium light (ML) and low light (LL) treatments. Under each light level, plants in salt treatments were exposed to salinities increasing in a stepwise manner (0 ppt, 6 ppt, 12 ppt, and 18 ppt) for 2 weeks at each level, during the second week of which PI curves and photosynthetic pigments were investigated. In HL and ML, salinities at 12 and 18 ppt reduced light saturated photosynthesis per unit Chlorophyll-A (chl-a), reflecting an ultimate reduction in Calvin-Benson cycle activity. Also in HL, salinity reduced chlorophyll content while salinity at 18 ppt reduced carotenoid content, indicating a reduction in light harvesting. Both light harvesting and carbon assimilation was reduced by salinity in HL. In ML only Calvin-Benson cycle was reduced by salinity at 12 and 18 ppt, while in LL photosynthesis was no different from the freshwater controls. Therefore, salinity and light synergistically affect the establishment of *Stukenia pectinata* in Te Waihora, where plants strive to reach the water surface for light and with each step closer to the water surface photosynthesis gets more constrained by salinity.



## Hydrogeological investigation of the Christchurch City Aquifer

### Logan McLean, MSc Candidate

logan.mclean@pg.canterbury.ac.nz



Regionally low levels of nitrate are prevalent in the coastal confined aquifer zone in and north of Christchurch. Although the reason for this is unknown, it is conceivably due to denitrification of the groundwater, or the groundwater pre-dating the beginning of agricultural intensification in the catchment. To investigate this, it is crucial to determine the physical properties of the groundwater system that influence the fate and transport of nitrate.

This research is a hydrogeological investigation of the Christchurch City Aquifer and will contribute important information to a larger project aiming to identify the potential for denitrification in the spring-fed discharge zone near Kaiapoi. The aim of this research is two-fold. Firstly, hydraulic conductivity and groundwater velocity estimates will be gained to create a vertical hydrogeological profile of the top 40 metres of the aquifer-aquitard sequence. Secondly, the methods used to obtain these values will be compared and evaluated.

Data collection involves performing slug tests (water level recovery) for determination of hydraulic conductivity, and groundwater velocity salt tracer tests on two sets of multi-tier wells installed in and near Kaiapoi. Sediment samples taken from these sites will undergo grain size distribution in the lab. The data from the core logs will be applied to empirical models to gain estimates of hydraulic conductivity. Slug test and groundwater velocity test data will be applied to analytical and 3-D numerical groundwater models. The numerical models are expected to yield the most reliable results.

#### Research/career interests:

- Hydrogeology
- Environmental science

## Analysis of slug test methods for use in the highly permeable Riccarton gravel aquifer

**Ben Mitchell, PMEG Candidate**

btm46@uclive.ac.nz



In virtually all groundwater investigations, it is necessary to have an estimate of the hydraulic conductivity of the subsurface material. One of the aquifer tests used to estimate the hydraulic conductivity in the field is the slug test method. Slug test methods can be difficult in highly permeable formations such as the Riccarton Gravel aquifer due to the fast rate at which the water returns to static water level. Review of the available literature has revealed that the preferred method of initiating a slug test in high-K aquifers is the Pneumatic slug test method. The aim of this research project is to implement the pneumatic slug testing method to gain a better estimate of hydraulic conductivity in the Riccarton gravel aquifer in the Ilam gardens well field. If the project is successful it will allow a single person to

perform slug tests easily on wells situated in the highly permeable Riccarton gravel aquifer. To the best of my knowledge, pneumatic slug testing is not widely used in New Zealand. Results will then be compared to more traditional methods of slug testing and will be presented during the final poster presentation.

### Research/career interests:

- Hydrogeology
- Engineering geology
- Groundwater flow modelling
- Management of groundwater

## How can Transformational Learning Theory (TLT) provide insight into business owners' perception of Water Resource Management?

### Rachel Teen, MWRM Candidate

rachelteen@icloud.com



Little is known about micro, small and medium enterprise (MSME) attitudes to and control of environmental impacts, particularly in regards to water resource management.

This poster expands on TLT's assertion that a major disruption to people's worldviews can trigger a series of critical reflections that may lead to a transformation in their thinking, perceptions, and actions.

TLT's founders, Jack Mezirow & Victoria Marsick (1978), assert our response to a 'disorienting dilemma' can be to critically reappraise the psycho-cultural assumptions upon which we have constructed our meaning perspectives. The reappraisal may instigate a new phase of development, a clearer insight into the cultural and psychological forces that previously limited our comprehension of and arrival at new perspectives.

Applying TLT to analyse responses from MSME's affected by the tragic 2016 campylobacter outbreak in Havelock North will examine the various stages of transformation that local business owners experienced and will increase our understanding of MSME's water resource management for future effective policy-making.

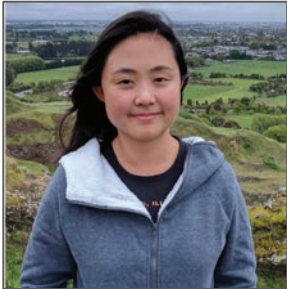
#### Research/career interests:

- Hydro-social cycle
- Urban contamination
- Sustainable policy-making
- Transformational learning
- Disruptive innovation

## Assessing seawater intrusion vulnerability associated with sea level rise in Christchurch, New Zealand using GIS-based methods

### Irene Setiawan, BAgSc(Hons) Candidate

Irene.Setiawan@lincolnuni.ac.nz



Seawater intrusion (SWI) is the landward movement of the seawater-freshwater interface in coastal aquifers. Causes of SWI include groundwater pumping, sea level rise, reduced recharge, and land drainage. Christchurch aquifers provide one of the highest quality untreated drinking water sources in the world, which local residents completely rely on for critical needs.

In this study, a qualitative GIS-based method called GALDIT (Lobo-Ferreira et al., 2007) is used to assess SWI vulnerability to sea level rise in Christchurch. To overcome limitations of these methods, the analytic solutions of Morgan and Werner (2015) were also applied within a GIS framework, for the first time. They are applied based on a 1 m sea level rise according to the RCP8.5 (highest emission) scenario.

#### Research/career interest:

- Hydrogeology
- Groundwater management
- GIS modelling

## Small-scale water sensitive urban design is a critical part of future stormwater management — do you agree?

### Vicky Southworth, MWRM Candidate

vicky.southworth@pg.canterbury.ac.nz



Stakeholder engagement is critical to enabling change and ensuring outcomes consider local circumstances – you are invited to leave your opinion on this poster using the sticky notes provided. This poster sets out how barriers to and opportunities for increasing the use of small-scale water sensitive urban design (WSUD) will be identified, leading to recommendations that could support an increased uptake of building-scale WSUD in Christchurch.

At its simplest WSUD means using devices and materials to reduce surface water runoff in urban environments by increasing reuse, infiltration and evapotranspiration, thereby mimicking the pre-development hydrological cycle. But to become a genuinely water sensitive city requires consideration of water in urban design and planning, as well as educating citizens to think about their choices and impact on water. By incorporating WSUD into existing and new urban development, benefits such as reduced flood risk and contaminant transport can be achieved. To date the uptake of WSUDs at the building scale (residential, commercial and industrial), such as permeable paving, rainwater tanks or rain gardens, has been low. Research shows that reducing runoff close to source is critical for high quality ecological outcomes. In addition, as urban density increases larger scale WSUD options are no longer viable. The Christchurch rebuild is well underway but urban densification and redevelopment of the central city means there is still an opportunity to incorporate WSUD more widely.

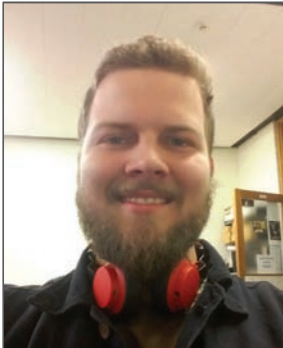
#### Research/career interests:

- Policy development
- Transition to a sustainable world
- Construction projects' master planning, design and management

## Eutrophication in coastal New Zealand lakes and the mitigation potential for phosphorous immobilisation using clay based amendments

### Sam Whitley, BAgSci(Hons) Candidate

Sam.whitley@lincolnuni.ac.nz



Water amendments were analysed in-vitro to identify their potential for phosphate sequestration in coastal lakes and water bodies, in an effort to reduce their trophic levels.

The potential amendments that were identified include: Allophane, Bauxsol™ (re-purposed from aluminium processing) and Phoslock® (lanthanum treated Bentonite), along with several other clays such as Kaolinite, Bentonite, and Illite as a comparison.

Each amendment was placed in a solution of phosphate, agitated, then left to settle over 24 hours. The remaining phosphate in the solution was measured with a UV spectrometer (880nm, ascorbic acid analysis). The results showed that the common clays (kaolinite, Bentonite, illite) had very low adsorbance potential, with an average of 6.15ppm of phosphate adsorbed out of a total of 50ppm. Phoslock® adsorbed 33.7ppm while allophane and Bauxsol™ adsorbed 11ppm out of 50 ppm.

The experiment showed that Phoslock® was the most effective at adsorbing phosphorus, an order of magnitude above the common clays, and has great potential for use in the lake. Allophane and Bauxsol™ also show promise, however, at pH 7 their adsorption capability was hindered. Further experiments will focus on the ability of these clays to function at a wider pH range, then finally testing the clays within the lake environment, as a final evaluation of their effectiveness in reducing trophic levels in the lake.

### Research/career interest:

- Water preservation and management

## About Our Platinum & Gold Sponsors

---



Environment Canterbury is the regional council for this magnificent region. In Canterbury we have one of the most astonishing environments in New Zealand – from the turquoise Lake Tekapo, the stunning Southern Alps, the widespread agricultural plains, and beautiful coastline – not to mention our ‘capital’ city of Christchurch – and everything in between. The regional council is responsible for this environment, with the community’s support and in collaboration with many other organisations.

The work of Environment Canterbury takes place under seven broad portfolios: the Canterbury Water Management Strategy; air quality; biodiversity and biosecurity; hazards, risks, and safety; planning, consents and compliance; transport, Greater Christchurch rebuild and urban development; and regional leadership. Within these portfolios, the regional council covers such things as the Harbourmaster’s Office, regional parks, coastal erosion, buses, freshwater quality, pest management, flood protection, and air pollution. Industry, and the economic impact of activity within the environment, are key to the council’s decision making.

We are proud to support the 2017 Waterways Postgraduate Student Conference. Water is the driving force behind much of our economy and protection of this precious resource requires science to mitigate negative impact to ensure that we have a positive impact.



Water New Zealand is the principal trade association representing the interests of the water industry. We have 1900 members representing Councils, engineering service providers and providers of goods and services. We are actively engaged in advocacy, development of technical guidance and industry engagement with the goal of driving consistency into the way in which water systems are operated.



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.



National  
**Science**  
Challenges

OUR LAND  
AND WATER

Toitū te Whenua,  
Toiora te Wai

The objective of Our Land and Water – Toitū te Whenua, Toiora te Wai – National Science Challenge is to enhance primary sector production and productivity while maintaining and improving our land and water quality for future generations. The way we use and manage our land and water will be transformed by: identifying and providing for innovative resilient land and water uses; building collaborative capacity in our communities; and creating and/or capturing greater value for our agricultural products in our global markets. These drivers, along with research to connect them, form the three themes Challenge research is addressing. The Māori title is “Toitū te Whenua, Toiora te Wai”. Toitū te Whenua – let the permanence of land remain intact; Toiora te Wai – let water abound. The title is an adaption of the Māori proverb, “toitū te whenua, whatungarongaro te tangata” – land is permanent while people come and go.



NIWA is New Zealand's leading provider of atmospheric, freshwater and marine research and applied science services.

Our vision is "to enhance the benefits of New Zealand's natural resources". Our research helps New Zealanders benefit from our natural environments, without compromising their ecological, recreational, cultural and spiritual value.

We also help New Zealand and Pacific communities build resilience to potential hazards associated with tsunamis and climate variability and change.

Our work takes us from the top of the atmosphere to the bottom of the ocean. We operate world-class facilities and employ world-renowned specialists in weather and climate, coastal and marine science, aquaculture, freshwater and estuarine science, fisheries, environmental data monitoring and management, and Māori environmental research.

Key assets include a fleet of ocean-going and inshore research vessels for our coastal and marine research activities and a wide range of commercial activities; a High Performance Computing Facility that underpins our sophisticated environmental modelling and forecasting capabilities, and our marine research centre at Bream Bay near Whangarei, where world-leading research aims to improve the viability and sustainability of commercial fish farming.

We employ around 670 scientists, technicians and support personnel, spread throughout New Zealand and a subsidiary operation in Perth, Australia.

As a Crown Research Institute we receive core funding from the Government to undertake research for the long-term benefit of all New Zealanders, and we also serve clients in many sectors on a commercial basis, including farming, forestry, horticulture, transport, energy, marine fisheries, and aquaculture.



Opus International Consultants is a leading international multidisciplinary consultancy renowned for providing high quality engineering and environmental services to meet community needs.

Our expertise and research capabilities deliver a deep understanding of how our communities live and interact with infrastructure. We partner alongside communities as trusted advisors to problem-solve and create infrastructure solutions that add real value. Put simply - we build what matters for future generations and put people at the heart of everything we do.

Opus has a long heritage of developing and managing New Zealand's strategic water infrastructure assets for energy production, irrigation, and drinking water supply. New Zealand faces some unique pressures and competing demands on its abundant water resources and natural environment. Our team has expertise in all aspects of fresh and coastal water bodies; their various linkages and storages, their variability in time and space and the interactions of human activity within natural and built environments. Whether it is obtaining, controlling, treating, disposing, containing or resisting it, water is a critical consideration for almost all areas of environmental, social, commercial and agricultural activity.

We have a full team of expert hydraulic engineers, system modellers, social and environmental scientists with a network of offices in New Zealand, Australia, Canada and the UK.

We would welcome your enquiry on career path opportunities within our organisation or as part of planning your educational objectives.



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 environmental 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

---

## Notes

---

## Notes

---

## Notes

---