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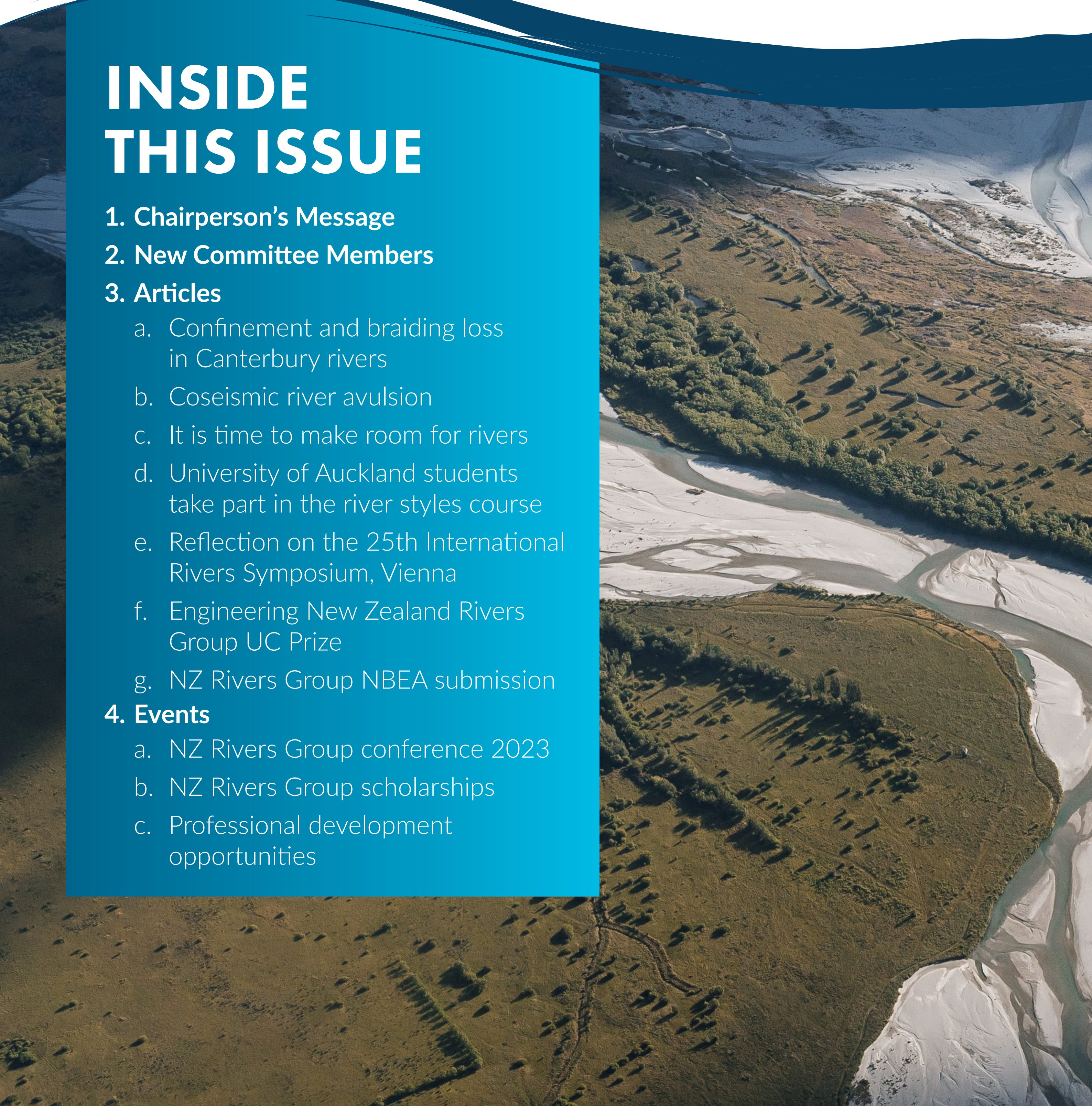
rivers
GROUP

A joint technical interest group of
Engineering New Zealand & Water NZ



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NEWSLETTER

Issue 39 | June 2023

FROM THE CHAIR

Hamish Smith

Kia ora koutou

There are some changes coming with the committee this month as well as for me, more on that later in the article.

It's the busiest time of year for many of us as we head into the end of the financial year. We all know that the river experts are stretched thin. Covid-era stimulus work, several years of major severe weather events hitting many regions, and now a higher inflation economy places pressure on us.

If you can, especially at this time of year, do try and support your workmates, celebrate successes and do what you can to be in the right head space for the challenges our lives and careers place on us this time of year. Do make use of resources like EAP if you have them at your work. Engineering NZ members can look at the free Āki wellbeing hub.

The committee has continued to move along initiatives. Richard Measures, our vice chair, has been working on our student grants and funding initiatives, you'll see comms on these and updates on our website soon.

The Regional Council River Managers SIG has continued to sponsor a number of workshops and events that we're promoting. Thanks for the members and committee members that have offered their time on these. This month Environment Canterbury's Shaun McCracken hosted the Riverine Ecology webinar series. Check out the RG members sections for access to our webinar video archive.

Selene Conn has done excellent work sharing job opportunities in our email updates and keeping our LinkedIn and Facebook feeds lively. Have a look, they are a superb forum for our community.

This year the conference themes will look into urban streams and flood risk management. Your conference committee chair this year is Amanda Death, who chaired our largest conference in Lower Hutt last year. The conference is in Nelson from 8-10 November 2023. Put a place holder in your calendar and reach out to Amanda for sponsorship opportunities. Keep a look out for announcements.

As for the committee update teased earlier, I regretfully announce I will step down as chair and from the committee this month. My wife and I are moving to her city of origin, Toronto. We are off on 21 June. Richard Measures will act as chair while the committee appoint a new vice-chair and consider if they need to co-opt new committee volunteers – reach out if you're keen and able!

It's been an honour (unfortunately a short one) to be the chair. The first interaction I had with the Rivers Group was back in 2011 helping Dr Grant Webby organise one of the early symposiums. I came onto the committee amidst the first lockdown in 2020 and set about organising our webinar series, a format that the Rivers Group has continued to bring in a great sized audience on.

The chair role I'll admit is challenging. There are many things to focus on with limited volunteer hours within an industry with massive challenges. Luckily the committee we have are all amazing humans and some of the top performers in our industry, and it's a pleasure to have some time to absorb some of their intelligence and passion, while trying not to be too intimidated by them! Do be patient with them, and we are all open to feedback.

As for my NZ career, I'm proud of the work I've been enabled to do at Greater Wellington building our capabilities around flood incident management, building our flood forecasting and warning capabilities, and laying the framework for better ways of working. For those that haven't given local government a go, it's a hugely rewarding space to work in, being close to strategic decisions and action on the ground. I've had a wonderful few years working with Andy Brown and the team at Greater Wellington. I've also had great support from others in NZ, a special thanks to those at Tonkin + Taylor (Jon, Alex, Mark and others) as well as KiwiRail (the two Daniels!).

It's a good time for me to reflect and consider where I should focus my efforts ahead.

As for the challenges in NZ, the reviews of recent floods and Three Water reforms should provide ample social licence to make changes with how we interact with our rivers.

My work at GW has shown me that if we put effort into sharing our resources and training our staff in emergency response, we can save lives and protect our rivers. There is work to do on creating a national way of approaching all aspects of flood risk management, including giving room to rivers, better flood response and warnings, and building defences thoughtfully designed for the future as well as investing in developing our careers.

Thanks to everyone for being a member and please continue to support the committee and each other. If you are able and willing, please consider contributing articles to our newsletter, ideas for events, or just reposting or commenting on our social media pages. Email us at rivers.group@engineeringnz.org.

Ngā mihi

Hamish Smith
Chair

NEW COMMITTEE MEMBERS

Lesley Smith

Lesley is the acting technical manager at Water New Zealand, the industry association for drinking water, wastewater and stormwater service delivery. Lesley is a trained electrical engineer but has spent the last fifteen years working in water infrastructure delivery. Her day job includes providing support to Water New Zealands special interest groups. These include climate change, stormwater and water efficiency groups which have several overlapping interests with the Rivers group. Lesley's role on the committee is to provide a link across related groups, as well as relevant Water New Zealands policy and training initiatives.

Shaun McCracken

Shaun McCracken is a Chartered engineer leading a team of river engineers and planners at Environment Canterbury. This role involves the delivery of flood protection to Canterbury communities through the design and management of stopbanks, vegetation, riverbed topography, and related works. Shaun is part of the national River Managers Special Interest Group which is a collection of Regional Council senior staff working in NZ rivers. His role for the Rivers Group committee will be to act as the conduit for information sharing and advocacy for the interests between these two leadership teams.

Verity Kirstein

Verity is a Senior River Engineer in the Rivers Section at Canterbury Regional Council based in Christchurch. As a geographer and civil engineer Verity's 20 years' experience encompasses flood and coastal risk management, asset management practices and construction project management in the rivers space in both England and New Zealand. Verity currently specialises in providing engineering solutions to flood and erosion problems, offering technical advice and guidance, and delivering integrated programmes of work for rivers throughout Canterbury. She has been a member of the Rivers Group for the last 7 years and joined the committee to volunteer time to a specialist interest group and share her passion for rivers.

CONFINEMENT AND BRAIDING LOSS IN CANTERBURY RIVERS

V. Barlow and P. Ashmore
University of Western Ontario, Canada

Research involving the worldwide loss of braided rivers has raised significant questions including how much constriction causes loss of braiding and how much room does a constricted braided river need to return to natural form and function? Answers to these questions apply directly to ideas about room for rivers. The research summarized here explores these questions by tracking and documenting the historic changes of several braided rivers from the Canterbury region that have undergone confinement, and by examining the relationship between river width and braiding in order to help develop ideas and principles for sustaining these remarkable riverscapes.

Methods

Nine rivers of different scale and braiding extent were selected, all of which were historically recorded as braided. The source data for this analysis was aerial imagery from the mid-1900s (a period of much less significant confinement on most rivers) and present (2012–2018). The comparative changes in river width and channel pattern were measured, including braiding intensity recorded as a simple count of the number of channels across the river. Segmenting the rivers at equal intervals (250, 500, or 1,000m, based on scale) along the length of the channels created over 1,000 segments of historic and recent data on river channel width and braiding intensity.

Results

On average, rivers have narrowed close to 50% over the past 60–70 years, with narrowing over 90% in some reaches (Figure 1a). Channel narrowing was linked to varying levels and types of confinement. The most common confining margins were stopbanks, planted vegetation, and agriculture, typically occurring within the historically measured active channels of the rivers (Figure 1c). The smaller scale rivers (such as Ashburton River) were most notably constricted by these confining margins, while the large-scale rivers, though becoming more confined, still maintain channel widths of hundreds of meters.

Loss of braiding, or braiding intensity, was observed in addition to, and in line with, these changes. Braiding complexity and occurrence have greatly decreased along all of the rivers (Figure 1b). On average, braided channel counts decreased 27% (or by ~1.3 channels). In some reaches this has been significant enough to cause changes in pattern type, most commonly, from braided to wandering. In total, over 100km length of the total rivers studied changed from a braided morphology to a less complex pattern (either wandering or single channel). While larger scale rivers remain with long reaches of braided defined segments (>3 channels), the smaller rivers have almost completely lost the braided morphology along their entire length. Overall, the rivers have severely narrowed and decreased in braiding complexity and occurrence, thereby changing the geography of braiding throughout the region.

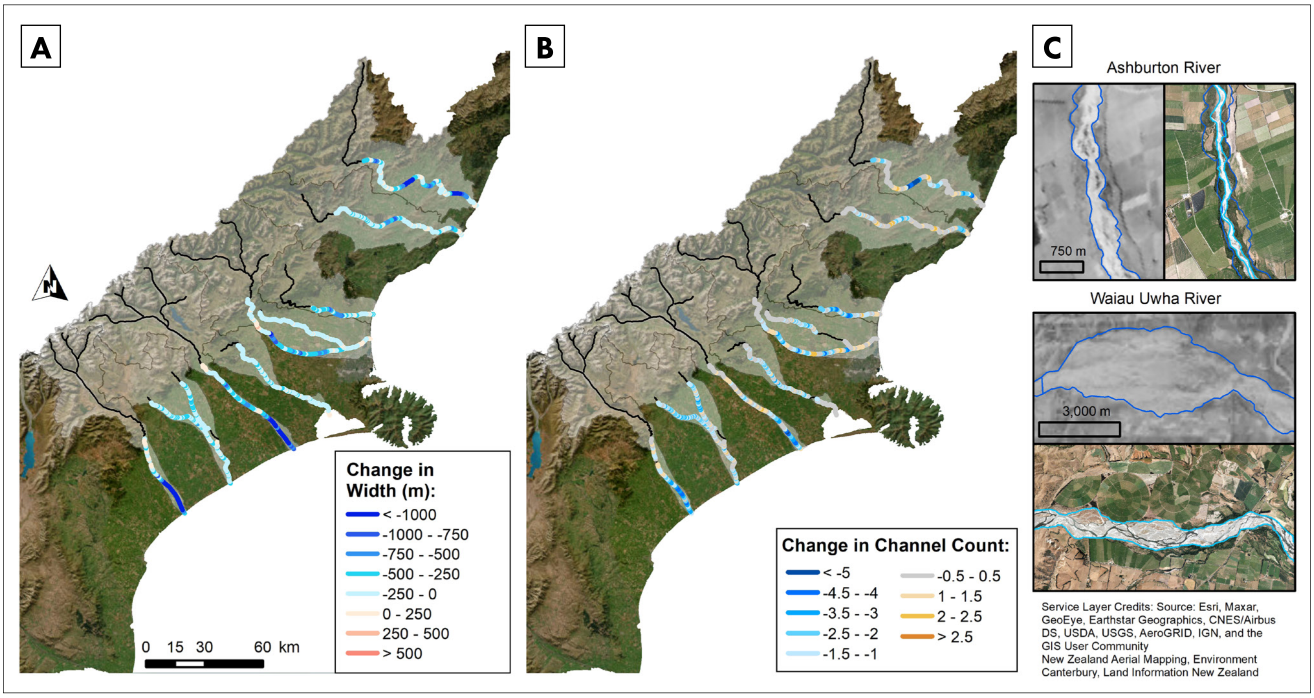

Figure 1: Map of (a) channel width narrowing, (b) channel pattern loss, and (c) examples of causes of narrowing.

The results also clearly show that channel narrowing results in a decrease of braiding intensity, and with enough narrowing may cause a shift from braided morphology to wandering or single channel (Figure 2). An outcome of this analysis was an understanding that braiding is scale dependent. Narrower channels (common to the small-scale rivers) are closer to a threshold condition for braiding and therefore require less narrowing than initially wide channels (common to the large-scale rivers) to see a change from braided to non-braided. In general, it was shown that there is a predictability to braided channel simplification and loss, though results have some uncertainty due to overlap between pattern definition and transitions.

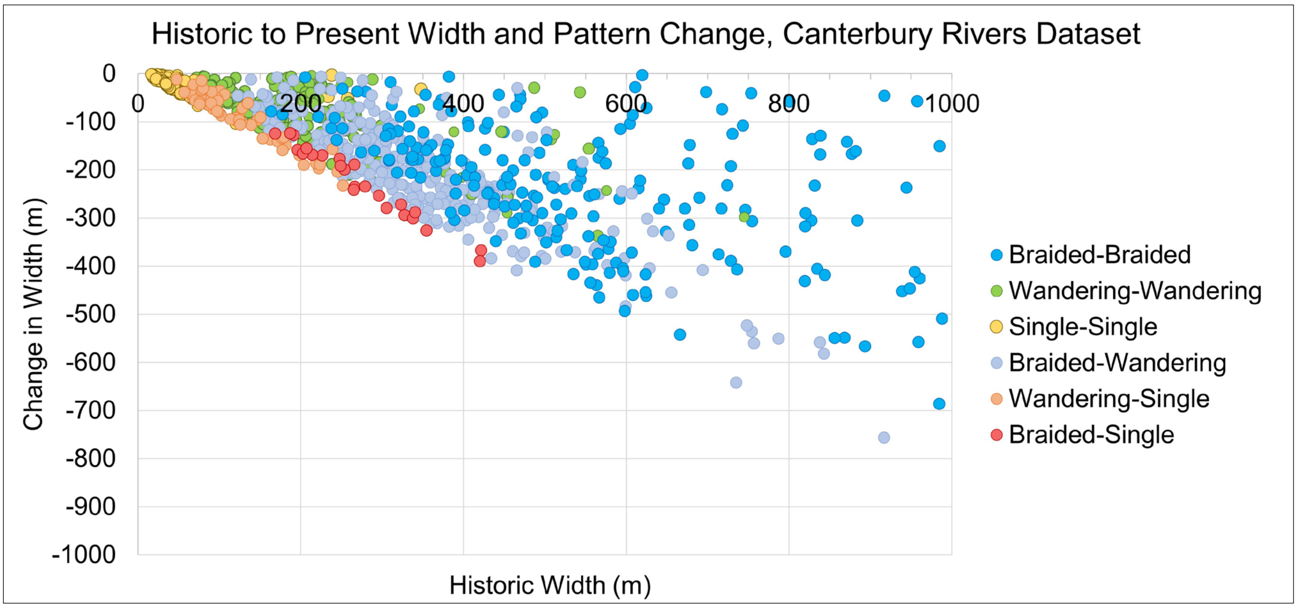

Figure 2: Measured historic width vs. change in width to present day. Colours represent change in pattern type (Historic-Present), note braided data continues to the right.

A width-based predictor of pattern change was created that can be applied to look at the effects of narrowing on both braiding complexity and loss (Table 1). This has potential application in aiding future river management plans for conserving braided river morphologies by identifying the likelihood of braiding loss given a certain amount of narrowing, or the potential pattern change if the river is given more room to develop laterally. These preliminary results could be modified using additional variables affecting channel pattern, and data from other gravel-bed braided rivers could be added to the dataset to see if the Canterbury results are applicable to braiding in general.

Table 1: Likelihood of braiding. Based on Canterbury rivers gravel-bed dataset.

Width Range (m)	0–100	100–200	200–300	300–400	400–500	500–1,000	>1,000
Likelihood of braiding	1%	23%	39%	60%	89%	96%	100%

Conclusions

All rivers face environmental pressures, including lateral confinement, land cover change (e.g. intensification of agriculture), water abstraction, major rainfall events, and climate change. Effective management of these rivers may reduce future management and restoration costs as well as risk and loss from flooding. One clear way to do this is to provide the rivers with enough space to naturally adjust and adapt to change although, under current land demand circumstances, complete freedom to braided rivers is unlikely and compromises will have to be made that can still maintain the braiding morphology. The results of this research show approximate minimum widths that rivers require to maintain a braided morphology and braiding intensity. This information may guide future river management by anticipating the effects of restoration plans or any further encroachment. By allowing the space needed for the rivers to naturally migrate and respond to changes, rivers may be restored to braided morphology, function, and habitat value.

COSEISMIC RIVER AVULSION: A HIDDEN HAZARD BENEATH OUR RIVERS

Erin McEwan[1], Timothy Stahl[1], Andrew Howell[1,2], Rob Langridge[2], Matthew Wilson[1,3]

New Zealand's mid-latitude position atop an active plate boundary means earthquake and flooding hazards are something New Zealander's actively expect and prepare for. However, the potential consequences of both hazards occurring simultaneously are often overlooked. This poses a significant challenge given that fault-lines intersect rivers in numerous locations across the country, sometimes in populated areas (e.g., the Hutt river and Wellington fault) or near critical infrastructure (e.g., the Taieri river and Titri fault). Despite this, the immediate response of rivers to surface rupturing fault displacements is not well understood. In 2016, the Kaikōura earthquake demonstrated why it is imperative we begin to give this subject some thought.

Fault-rupture induced river avulsion (FIRA): A New Zealand case study.
In the early hours of November 14th, 2016, a Mw 7.8 earthquake occurred as >20 crustal faults progressively ruptured throughout the North Canterbury and Marlborough regions. The aftermath of the earthquake revealed significant geomorphic changes, with a startling discovery that several rivers had partially or completely changed course overnight. This phenomenon (referred to as avulsion) occurred due to surface rupturing faults emerging within active river channels, causing fault-rupture induced river avulsion (FIRA) events. The most notable FIRA event occurred ~33 km north of Kaikōura, where the Papatea Fault ruptured and produced ~6.5 m of vertical, and ~4.6 m of lateral displacement within the parent channel of the Waiau Toa | Clarence River. The displacement occurred downstream of river flow direction, effectively damming the channel and leading to a partial avulsion. A significant amount of river flow was diverted south-east along the Papatea fault scarp, inundating a large area of farmland, and creating a large coseismic lake that persisted in the landscape for ~7-8 months (Figure 1A). In the weeks following, local farmers constructed a stopbank in a desperate attempt to redirect flow back into the parent channel. While temporarily successful, the next flood event destroyed the stopbank and allowed the river to once more reroute along the fault scarp. With time, the Waiau Toa | Clarence River abandoned its pre-earthquake parent channel in favour of the avulsion channel, which has now developed into a sprawling braid plain. Modern satellite and drone imagery reveals that the avulsion channel reaches up to ~450 m in lateral extent, and has scoured ~4–5 m down into what was once productive farmland (Figure 1B). Flooding patterns and hazards in areas around, and downstream of the fault have changed considerably since the 2016 earthquake.

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Figure 1A: The Papatea Fault rupture and Waiau Toa | Clarence River coseismic avulsion. The Papatea fault produced ~6.5 m of vertical, and ~4.6 m of lateral offset downstream of the river flow direction (shown by the arrows), causing the river to partially avulse (Image adapted from McEwan et al 2023).

Figure 1B: The Waiau Toa | Clarence River floodplain as of November 2021, showing the extent of the geomorphic changes occurring within the Waiau Toa | Clarence river valley since the 2016 earthquake. The red circle marks the location of 4WD vehicle sitting directly atop the Papatea fault scarp, providing a sense of scale. All river flow now routes along the Papatea fault scarp, scouring out a channel up to ~450 wide, and cutting down into the floodplain by ~4 – 5 m.

Creating a hydrodynamic flood model: can FIRA events be predicted?

Within New Zealand, many active faults have now been mapped, and we know something about the manner in which they typically deform. In addition, many of our rivers are gauged, allowing us to constrain their average flow and flooding behaviour. After looking at the available data, we questioned if it may be possible to predict FIRA events ahead of time. In our new study, we attempt to answer that question. We use the 2016 Papatea fault rupture and Waiau Toa | Clarence river avulsion to examine FIRA events in greater detail, and attempt to understand if this event could have been predicted ahead of time using hydrodynamic modelling. This article provides a general snapshot of our findings, however the full study and results can be found at https://www.science.org/doi/10.1126/sciadv.add2932.

Excellent pre-and-post event satellite imagery (Figure 2A) and lidar following the 2016 Waiau Toa | Clarence River avulsion provided a unique opportunity to examine FIRA events in more detail. Fault kinematics were measured in the field, and a local bridge gauge measured a flow rate of 187 m3s-1 only one hour prior to the fault-rupture, providing us with event flow conditions. With this information, we constructed a HECRAS 2D hydrodynamic flood model, with two initial goals. This first was to reproduce the Waiau Toa | Clarence river FIRA event as it occurred in 2016 (the benchmark model), and the second was to ascertain if the avulsion could have been predicted ahead of time with some knowledge of fault location and kinematics (the calibration model). The benchmark model uses a DEM constructed from lidar taken 1.5 months after the earthquake and is representative of the natural post-earthquake landscape and fault scarp (Figure 2B). The calibration model uses a pre-event (2012) DEM deformed with a synthetic fault scarp, reflective of the real-world Papatea fault location and slip vectors (Figure 2 - right). Both models produced performed well, and recorded high spatial accuracy scores when assessed using a binary confusion matrix approach. These results indicate that with some knowledge of fault location, rupture style, and river flow behaviour, changes in flood patterns following seismic events can potentially be predicted ahead of time.

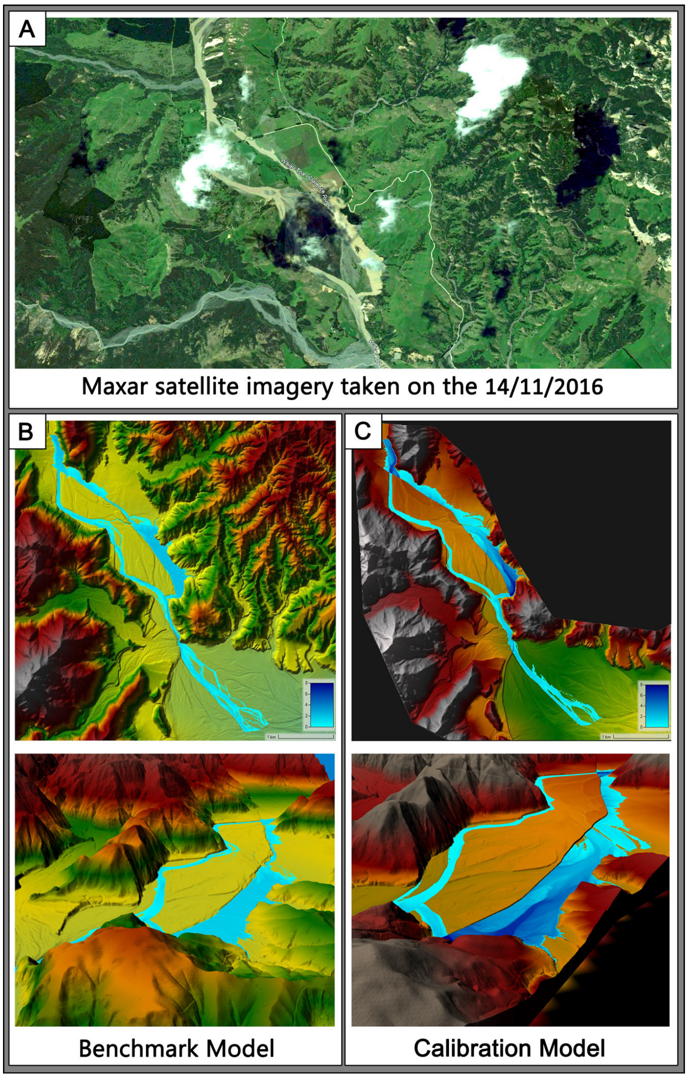


Figure 2A: Maxar aerial imagery of the Waiau Toa | Clarence river avulsion, taken on the day of fault-rupture.

Figure 2B: Benchmark results reflect the real post-event landscape and the natural Papatea fault-scarp.

Figure 2C: Calibration model results are produced using a (pre-event) 2012 DEM, modified with a synthetic fault scarp calibrated with Papatea Fault displacement vectors. Both models return high spatial accuracy scores when compared against the satellite imagery.

A challenge of this approach is that even with excellent river data, and constraints on fault location and rupture behaviour, it is impossible to precisely predict the manner in which a fault will rupture or the flow conditions of an affected river at that moment. However, the style of offset and approximate displacement of many of New Zealand's most active faults are known, and many rivers are monitored, allowing for the calculation of flow regimes such as mean annual flow or mean annual flood. This information can be used to explore FIRA scenarios and predict the thresholds at which rivers may undergo avulsion in response to fault-offset.

When implementing this approach to the 2016 Papatea fault and Waiau Toa | Clarence river site, we made several important findings. Notably, we discovered that at lower fault offset values, coseismic flooding and avulsion may not occur unless the discharge regime is high enough (illustrated in Figure 3). This has significant implications when considering flood hazards related to these events. Specifically, it means that a fault-rupture may not immediately result in a flood if the river is in a state of low flow, which can lead to the surrounding populations assuming that the river has not been affected. However, the river may undergo a coseismic avulsion at a later time, when river discharge increases. This can then generate unexpected flooding in locations that were not previously considered at risk.

Why does it matter?
Our findings suggest that coseismic alterations of river flow paths can produce immediate, spatially extensive, and prolonged alterations to flooding patterns and hazards in areas where faults and rivers intersect. This is concerning, as many other examples of FIRA events are found globally and within New Zealand. In 2010, Canterbury's Hororata river avulsed in response to offset produced by the Greendale fault, flooding >40 ha of farmland via overland avulsion and paleochannel reoccupation. In 1812, the Reelfoot fault ruptured in New Madrid (USA), temporarily blocking the Mississippi River, and permanently damming the Reelfoot river. The expansive ~53 km^2 Reelfoot Lake formed in response, which still remains in the landscape today. Many more examples can be found, and in most FIRA case studies, flooding patterns are permanently altered, even if the river resumes its previous course.

Although New Zealand is home to thousands of fault-river intersections, earthquake and flooding hazards are often considered independently, even though they can occur concurrently. As such, we emphasize the need to consider earthquake multi-hazards, especially with the increasing impact of climate change. In the coming century, flooding events may become more frequent and severe in some parts of the country, and flood models that fail to account for active faults may therefore underestimate the extent, severity, and spatial distribution of inundation following seismic events. All the more reason why we need to give our rivers, and what lies beneath them, room to behave dynamically.

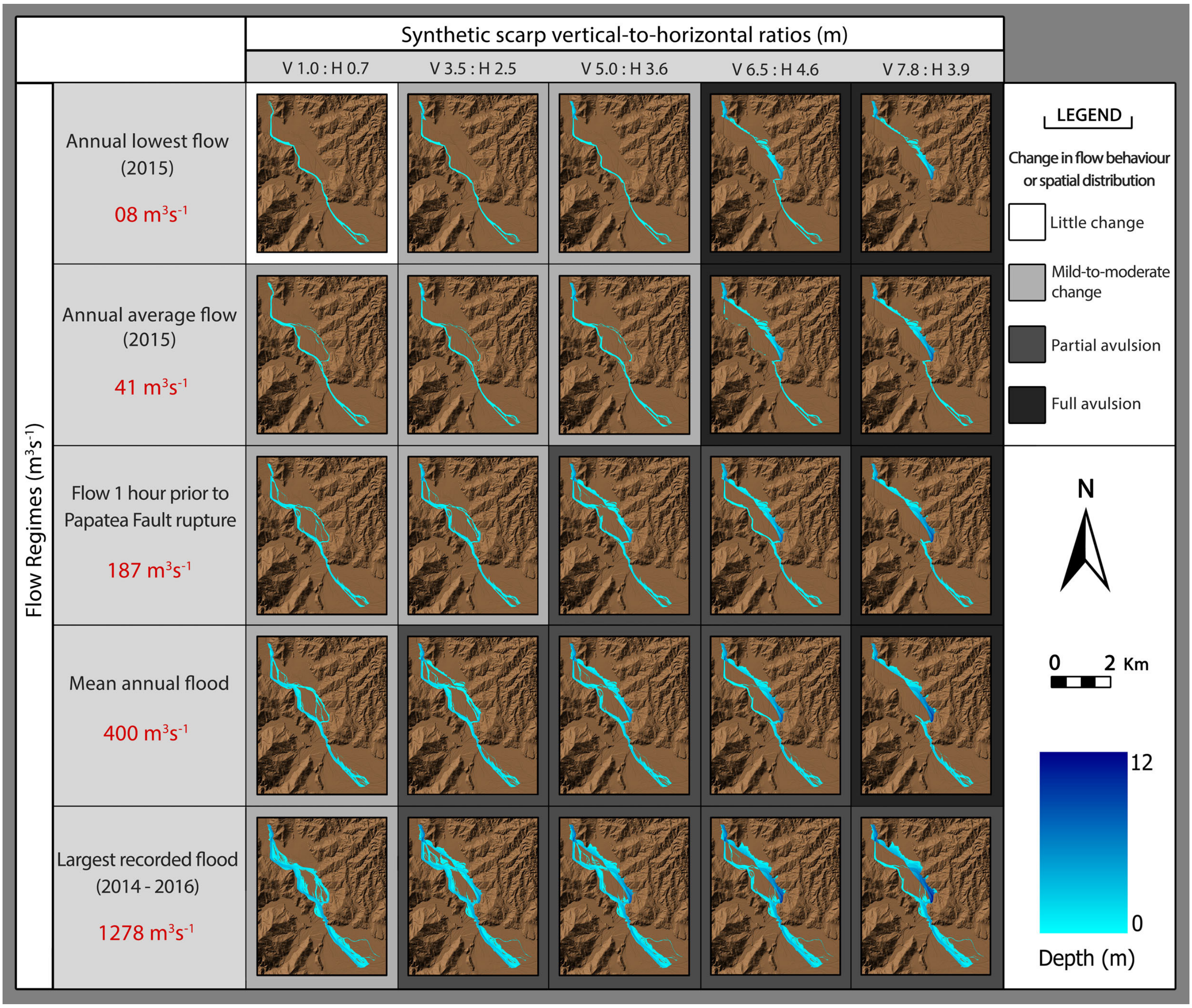


Figure 3: Twenty-five scenario model of the Waiau Toa | Clarence river FIRA event, combining 5 flow regimes (left) and 5 displacement regimes (top) ranging from 1.0 m–7.8 m of vertical displacement. These scenarios allow us to examine what could have occurred in the Waiau Toa | Clarence river valley had fault displacement, or river flow conditions been different at the time of the 2016 Papatea fault rupture. Applying this method to other fault-river intersections within New Zealand may allow us to quantify what fault-and-flow conditions can generate immediate, or delayed coseismic flooding and avulsion events (McEwan et al 2023).

OPINION | IT IS TIME TO MAKE ROOM FOR RIVERS

Tom Kay
Forest & Bird

In the early hours of 14 February 2023, as Cyclone Gabrielle smashed Te Tairāwhiti and the wider Hawke's Bay regions, the flow gauge on the Tutaekurī River upstream of Napier dropped offline.

The river was flowing at over 1,800m^2 per second when the gauge cut out – that's 1,800 tonnes of water flowing past the recording point every second – and it continued to rise through the night to what is probably the highest flow ever recorded in the river.

Figure 1: Cyclone Gabrielle flooding from corner SH50 Omarunui Rd in Hawke's Bay on 14/02/23 (Credit: Steve Dighton).

Just after 8am that morning the river took out the Redclyffe substation, cutting off power to much of Napier, and by 10am residents in suburbs near the river – including my parents, sister, brother-in-law, two-year-old niece, and five-year-old nephew in Taradale – were being told to evacuate immediately.

In an updated Facebook post at 10:36am, Hawke's Bay Civil Defence said flood protection systems on the river were "failing to contain floodwaters". The river was overtopping the stopbanks on both sides and risked taking them out completely as it continued to rise.

It was then that my brother and I – in Auckland and Wellington respectively – got a message in our family chat. My sister and her kids had just left their place with help from my Dad, wading through floodwaters outside their house to get to his car before driving some 600m to our family home in Taradale, further from the river and on slightly higher ground.

At that point we pretty much lost communication with our family. Phone networks were struggling or completely cut out. Twenty minutes later I got a call from my brother saying he'd managed to get through to them – they were preparing to leave Taradale and head to higher ground at a friend's place. Then we waited, hoping they were out of harm's way and trying not to worry.

I sat anxiously in meetings at work and pretended things were fine. By mid-afternoon we connected with them again. But they said people weren't evacuating. Some had seen the river lowering and figured it was now safe to stay – unaware that the river continued to eat away at the stopbank below the surface of the floodwaters.

With power and internet down, messages from civil defence weren't necessarily getting through, and the sense of urgency seemed to be lost as messages were relayed. People were still in Taradale, still at home, and still in the potential path of the river. My family reassured me they were leaving.

By 4pm the Tutaekurī River was dropping. The stopbank held. Residents of Taradale were allowed to return. My family was lucky. They lost power for six days, but our family home was spared.

But homes in neighbouring streets were flooded. The community in Waiohiki, across the river from Taradale, was flooded. At least two bridges on the river were taken out. We knew nothing of the impact elsewhere in the region at the time – the surrounding rivers and floodplains inundated, the scale of destruction in nearby communities. People's lives lost.

Figure 2: Redclyffe bridge in Hawke's Bay post Cyclone Gabrielle 16/04/23 (Credit: Thomas Kay).

The flooding during Cyclone Gabrielle is the latest of what must be at least 10 serious flooding events over the past six years. Together they've caused huge damage and stress to communities across Edgecumbe, Canterbury, the West Coast, Tairāwhiti, Nelson, and Auckland – often several times over in each region. But February's flooding was different to those events before. None of those floods resulted in the loss of life seen during Cyclone Gabrielle.

While I'd like to think we will learn from this event, our collective memory is short. Nothing substantial changed following Westport, Canterbury, or Nelson's experiences of rivers overtopping banks, destroying infrastructure, and threatening lives. There were calls to build bigger stopbanks in response. Already, there are calls to do the same in Tairāwhiti and Hawke's Bay – to rebuild houses in the same places, to repair and increase the height of stopbanks that were overtopped and cut through.

These are calls to put our communities back in harm's way.

Unfortunately, as climate change continues, we're going to experience more frequent and intense rainfall across the country. This will bring higher river flows and more flooding than ever before. And with that comes a greater risk of people being caught in harm's way, again. More evacuations. More lost communication. More families and communities torn apart. But it doesn't have to be this way.

It's hard to talk about in the wake of disaster, but I believe an open, public discussion within the communities most affected by these traumatic events is the only way we can reduce the chance of this happening again.

Cyclone Gabrielle has shown us the approach we have taken to try and protect our communities from flooding has not worked. Across Hawke's Bay, and across New Zealand, we have deforested our hillsides. We have drained wetlands. We have moved onto floodplains and narrowed our rivers into massive stopbank-lined drains. When rain starts to fall there is nothing to slow it down.

The stories emerging from Hawke's Bay and Tairāwhiti have been harrowing and tragic. But as communities recover from the impacts of Cyclone Gabrielle, we can lower the chances of this happening again if we take the opportunity to build better and safer communities.

Late last year, a group of experts[1] wrote that our approach to living with rivers in New Zealand is not working – that, "working against nature does not work" and we "may inadvertently be manufacturing future disasters". But they also said that the solution was simple: "moving out of harm's way saves lives".

We must make room for rivers – backing off their floodplains and giving them more space to flood safely, with no one left in harm's way. We must restore wetlands to hold rain and reforest hillsides in native trees to hold soil and prevent us losing thousands of tonnes of soil in every storm, evidence of which now rests in people's streets and homes.

Imagine if our rivers had more width between their stopbanks or across their floodplains to flood gradually and safely. If our communities knew the historic paths of our rivers and avoided living in them. If our orchards and farms were designed to make the most of the nutrient-laden sediment spread through them. If we had no homes in the path of floodwaters. If wetlands bordered our rivers and buffered our highest risk floodplains.

1 Brierley et. al. (2022). Reanimating the strangled rivers of Aotearoa New Zealand. WIREs WATER, 10(2). https://doi.org/10.1002/wat2.1624

Not only would our communities be safer and more resilient, but they would be healthier and happier – as would the rivers and wetlands themselves.

We can build a thriving and safe community as we work together to slow and adapt to the impacts of climate change. We can build something better. But it will take political and community leadership. People willing to support one another. And a collective acknowledgment that we cannot beat nature – it always wins. But if we look after it, it can look after us. We cannot repeat the same mistakes. Aotearoa needs climate action. We must change – and now is our chance.

Tom Kay grew up in Taradale, Napier and now lives in Wellington, where he works as Forest & Bird's Freshwater Advocate. He has a BSc in Environmental Science and an MSc in Ecology from Massey University.

Tom is touring Aotearoa speaking to communities about Making Room for Rivers. See The Forest and Bird Website for dates and locations of further presentations, or contact freshwater@forestandbird.org.nz

UNIVERSITY OF AUCKLAND STUDENTS TAKE PART IN THE RIVER STYLES COURSE

Jacqui McCord
University of Auckland

Two students from the University of Auckland, Jacqui McCord and Megan Thomas, traveled to Goulburn, Australia to take part in the five day River Styles course facilitated by Gary Brierley and Kirstie Fryirs in association with Macquarie University, Sydney. Goulburn is located in the Tablelands region north of Canberra and hosts a wide array of river morphologies, many unique to the Australian environment due to the arid and tectonically stable landmass.

Photo 1: From left, Kirstie Fryirs, Jacqui McCord, Gary Brierley and Megan Thomas at Carrington Falls.

The four stages of the River Styles Framework provide a coherent procedure to interpret river character, behaviour, condition and recovery potential to inform catchment management that is founded in geomorphic principles. The course we attended covered the first stage which is the assessment of character and behaviour. At its core, this includes a systematic way of naming riverscapes based on the valley setting, river planform, geomorphic features and bed material. Analysis of these attributes informs determination of how a river can adjust on the valley floor and whether the watercourse is in a stable state or in an aggradational or degradational stage. When applied on a catchment scale, the different River Styles can be used to identify patterns and to pinpoint threatening processes such as headcuts and sediment slugs that may impact on upstream and downstream reaches if not addressed. The patterns of River Styles can inform prioritisation of remediation efforts, with the ethos being to protect the good bits first and to prevent issues from developing, rather than working in areas that are already in a highly degraded state. Ultimately, this conservation first ethos that works with recovery leads to cost savings and allows the river to do the work in self-healing.

The course had a balance of theory and fieldwork and covered a wide diversity of valley and river morphologies, from wide, expansive valleys to confined gorges. Geomorphic units are the building blocks of a riverscape and allows for the interpretation of processes. Their identification is key to understanding the behaviour of the reach, and different types of geomorphic units form based on the bed and bank material. The mapping of geomorphic units was undertaken through the use of aerial photographs and DEM's, followed by field verification. We visited bedrock, bedload and fine-grained rivers at different locations in the catchment to see the different geomorphic units and how they vary along the long profile.

The highlight of the trip was the Carrington Falls in Kangaroo Valley, a 90 m high waterfall that flows over the Great Escarpment and has carved out a substantive gorge. Upstream of the falls, the gently sloping plateau has facilitated the development of swamplands high up in the catchment.

Photo 2: Carrington Falls on the Kangaroo River.

A unique River Style to the Australian tablelands region is known as the chain-of ponds. The Mulwaree ponds which we visited are a series of ponds on the valley floor which research indicates have formed in the meander bends of the paleo river system and the one we saw was about 10 m deep. The ponds are connected by preferential flow paths that are engaged during rain events. However, many of the ponds are threatened by headcut formation which is incising the flow paths between the ponds and threatening the ponds. The identification of these headcuts is vital if these unique rivers are to be protected.

Photo 3: An example of the chain-of-ponds located along the Mulwaree River.

We took a slight detour during the trip to visit the Mulloon Institute who have been undertaking remediation work along 50 km of Mulloon Creek as part of a sustainable agriculture and environmental regeneration programme which began in 2005. The project has facilitated the placement of a series of leaky weirs to prevent upstream headcut propagation and to reinvigorate the floodplain. Research has shown that since weir placement, the water level has risen which has in turn increased flora and fauna, improved water quality and increased agricultural productivity.

Photo 4: A leaky weir placed along Mulloon Creek.

In total, we visited 15 different sites on 9 different rivers. We practiced River Styles naming upwards of 20 times and saw too many geomorphic units to count across the different river systems. Most importantly, we came away with a greater appreciation of river diversity and how important it is to know your catchment for planning restoration efforts.

REFLECTION ON THE 25TH INTERNATIONAL RIVERS SYMPOSIUM, VIENNA

Sarah Worthington
Environment Canterbury

In November 2022, I had the privilege of attending the 25th International Rivers Symposium in Vienna. With over 100 speakers covering a wide range of topics, the symposium was incredibly interesting and there was something to learn from everyone. Building on the recent Rivers Group conference, the discussions with international colleagues highlighted both the similarities and differences in the work and challenges for freshwater and river management professionals across the world. Here are some of my personal take-home messages:

1. **Scale and Resourcing**
   Many of the rivers and basins/catchments discussed at the symposium are of a dramatically different scale than those we work with in New Zealand, often spanning multiple countries. While this is something we all know, hearing about the management challenges and successes in these locations really put some things into perspective.

   The level of resourcing available to us (both financial and labour) is extremely limited when compared to projects happening in other countries. We should celebrate our successes and share our solutions with the international communities. You don't need a huge pool of resources to make a big difference. We do amazing work with what we've got. Working with limited resources fosters unique and practical solutions that our international colleagues would value.

2. **Communication, Communication, Communication**
   Effective communication was a consistent theme throughout the symposium. Societal change in river restoration and management relies on improved understanding and engagement from river communities. Every project found that communication and engagement was fundamental to success, and that doing this well takes time (often years and sometimes even decades).

   One campaign that caught my attention was the 'Save the Blue Heart of Europe' initiative. This is a multi-faceted campaign that encompassed several groups, including 'Scientists for Rivers', 'Artists for Rivers', 'Lawyers for Rivers', and 'Activists for Rivers'. Each group plays a vital role, utilizing their expertise and knowledge to effect change. The input from all parties, particularly the scientific community, proved crucial in bringing about significant changes in government and industry. The success of this campaign was most recently demonstrated by the establishment of Europe's first Wild River National Park along the Vjosa River. It's unlikely this significant milestone would have been achieved without the collective efforts and voice of river professionals across sectors.

3. **‘The way that humans will experience climate change is through water’**
   The symposium highlighted the significant impact of climate change on water resources, and how it is likely to affect/is already affecting various rivers and their surrounding communities. Several countries and river basin commissions presented their work on forecasting impacts and future-proofing communities. I think it helpful to keep this quote in front of mind as we navigate climate change impacts and work towards building resilience in a New Zealand context.

4. **‘We need to value rivers as rivers’**
   At the symposium, one of the speakers issued a challenging statement early on - “even the water sector undervalues rivers.” This was demonstrated by the stark fact that COP 27 in Egypt in 2022 was the first-time rivers have been mentioned in a UN COP Communique. The symposium widely recognised consistent undervaluing of rivers as a key contributor to the divide between water-related disciplines and legislation across Europe. We need to ensure rivers have a voice at the table. Different sectors and disciplines in the water sector must work together to achieve success. River communities need to understand and value rivers for their intrinsic and multiple values, rather than viewing them solely as a hazard to manage, a channel for water, or a resource to utilise.

I cannot understate how helpful it was to learn from and be a part of these discussions internationally. I noticed a lack of representation from the operations side of river management and government sectors. My comments about the realities of work on-the-ground were often met with surprise and gratitude. There is value in all voices being in the room and I highly encourage anyone who has the means and opportunity to attend the next symposium in Brisbane.

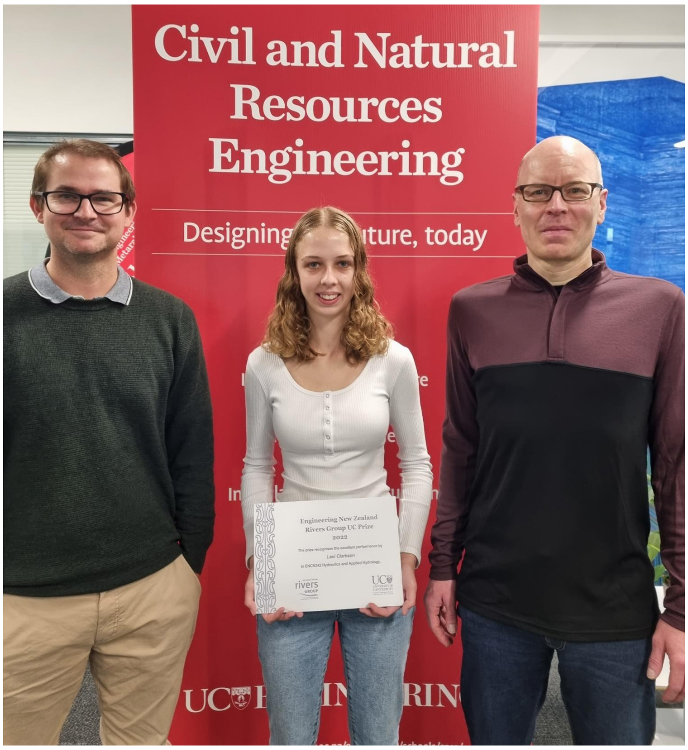
I will leave you with my final take-home message from this experience. Our rivers in New Zealand are unique and often faring much better environmentally than many of the rivers in Europe. Hearing the often-depressing stories of the state of our international rivers inspired me to keep working hard to make sure we are smart about how we manage our rivers at home. We are still able to access wild rivers throughout our country and this should be celebrated and protected. Let’s learn from our international colleagues, keep up the good fight and share our experiences as we continue to adapt and learn on our own journey to river resilience.

ENGINEERING NEW ZEALAND RIVERS GROUP UC PRIZE AWARDED TO LEXI CLARKSON

Lexi Clarkson, final year BE(Hons) in Natural Resources Engineering, is awarded a monetary reward by Engineering New Zealand Rivers Group in partnership with Te Whare Wānanga o Waitaha | University of Canterbury. The prize recognises excellent performance by undergraduate students at University of Canterbury in the core civil and natural resources engineering course Hydraulics and Applied Hydrology.

From the award recipient:
"My name is Lexi Clarkson, and I am in my final year of my BE(Hons) in Natural Resources Engineering at the University of Canterbury. I am really interested in water engineering, particularly hydrology and stormwater engineering. I enjoy the mathematical aspect of fluid mechanics, as well as the clear real-world applications of concepts we are learning. This year I am extending my studies in fluid mechanics with a groundwater and surface water modelling course, and an environmental fluids course.

During the past two summers I have completed internships in the water infrastructure team at Pattle Delamore Partners. I had the opportunity to work on a variety of stormwater and water supply projects, involving skills I have learnt in my fluid mechanics and stormwater engineering courses. I will be returning to PDP next year as a graduate environmental engineer, where I hope to develop my hydrology modelling skills and tackle environmental problems."



From left to right: David Dempsey (Hydraulics and Applied Hydrology course coordinator), award recipient Lexi Clarkson, Markus Pahlow (NZ Rivers Group representative).

NZ RIVERS GROUP NBEA SUBMISSION

NZ Rivers Group made a submission on the NBEA - one of the key bills that seeks to replace the RMA. You can read our submission on LinkedIn.

This action was supported by our members at the NZ Rivers Group 2022 conference. Our submission, aligned with the "Braided Rivers: The land the law forgot" submission, seeks to improve the act through better legal definitions, that represent the dynamic nature of rivers. Thanks to the committee and members who helped prepare this.

EVENT CALENDAR

NZ Rivers Group Conference 2023

Watch this space! The NZ Rivers Group is working hard to put together an exciting and insightful conference for 2023. The Living with Urban Rivers conference is scheduled to be held from 8–10 November in Nelson. The conference will build on last year's theme and look at how we live with flooding of our urban rivers in the face of climate change and a growing population.

For more information on the conference visit the website.

If you are interested in sponsoring this year's conference please email the conference chair, Amanda at amanda.death@gw.govt.nz

NZ Rivers Group student research grants

Funding available
The Rivers Group has three $1000 grants available to student researchers working on issues related to Aotearoa's rivers and catchments. This includes projects relating to flood risk management, Te Mana o te Wai, river geomorphology, water quality or water quantity.

Funding will be provided to support costs related to research such as fieldwork or laboratory related costs, equipment or software. The fund is not intended to cover tuition.

Eligibility
- Applicants must be enrolled at a New Zealand university.
- Honours, Masters and PhD level projects are all eligible for funding.
- Applicants must be members of the NZ Rivers Group (student membership is free!)

Application process
Applications require:
- A short application form.
- A note of support from an academic supervisor.
- An itemised budget for the proposed research.

We are in the process of updating the website – if you can't see the application form on our website please email rivers.group@engineeringnz.org to receive an application form.

Applications will be assessed on the strength of the proposed research and its alignment with the objectives of the rivers group.

Application deadline 31 July 2023

NZ Rivers group co-funding for industry led research

Funding available

The Rivers Group has $15,000 co-funding available to support a scholarship for an industry-led masters research project on a river related topic. This includes research relating to flood risk management, Te Mana o te Wai, river geomorphology, water quality or water quantity. This funding represents 50% of the costs of providing a full scholarship for a one-year masters research project.

We are looking for proposals from organisation who have a suitable project which would benefit from research and can provide the other 50% of funding for a scholarship.

What is required?

- An appropriate research idea: This could be anything river related.
- $15,000 co-funding toward the research scholarship. In return you will have a student full time for approximately one year to research the questions you have identified. This is a substantial amount of research, with expert supervision from university academic staff, which can help deliver knowledge of value to your organisation.
- Optionally you may also want to provide some co-supervision of the student project, or potentially host them in your organisation for part of their project – we would encourage both.

Next steps

Before 31 July 2023:

1. Contact us with your idea for a research project (rivers.group@engineeringnz.org or any of the committee members).
2. Identify potential academic supervisors and work with them to flesh out the project scope. If required, we can help identify an appropriate supervisor (you may already have a supervisorin mind – that's fine).

The Rivers Group committee will then select a project to support based on the strength of the proposed project and its fit with the aims of the Rivers Group. Priority will be given to projects which provide knowledge with wide applicability to the industry as whole. Local case-study type projects will be considered provided their findings can be generalised to other similar issues elsewhere.

Once a project is selected for funding the Rivers Group will work with the organisation and university to set up the scholarship and identify a suitable student.

Professional Development Opportunities

For those interested in the flood risk area, various online training opportunities in the form of digital badges are available on the IPWEA NZ's website. There are 3 courses in the flood risk learning framework starting with WM 104 – Introduction to Flood Risk Asset Management, then taking a deeper dive into key areas with WM 240 – Inspection and Performance and WM 241 – Risk Management and Planning.

Sources to find out more about professional development opportunities are e.g. the NZ Rivers Group website or the Resilient Rivers Communities professional development programme webpage.

Note that past NZ Rivers Group webinars can be accessed in the NZ Rivers Group members area.

CALL FOR CONTRIBUTIONS

We are always looking for contributions from our membership for FLOW. Consider submitting an article, case study, update or notice for the next issue.

The submission deadlines for 2023 are:

Issue	#	Deadline for contributions
September 2023 issue	#40	Monday, 14 August 2023
December 2023 issue	#41	Monday, 13 November 2023

Please format your contribution as follows:

- Length of around 500–1,500 words, preferably in Microsoft Word format (Articles should include: title, name of the author(s), affiliation(s), and section headings. Note that illustrations and/or tables are strongly encouraged)
- If possible, attach figures/images/artwork, e.g. in .jpg format, at high-resolution separately
- Provide credits and captions for your figures/images/artwork

If you have articles which are longer, please email us and we will work out a way forward together with you.

Email rivers.group@engineeringnz.org to submit your FLOW contributions or any news you want to share. We look forward to receiving your contributions.

RIVERS GROUP MANATIAKI KŌAWA MISSION STATEMENT

The New Zealand Rivers Group Manatiaki Kōawa was formed in 2009 to provide a forum for 'Working with Rivers'. It is a place for people with an interest in rivers, flood risk management and the operational and environmental issues of catchments and river systems to come together.

We currently have over 300 members, and promote a multi-disciplinary approach to river management, reflecting cultural and societal diversity in an integrated and holistic manner. Our membership reflects this, with our members coming from a wide range of river management, science and engineering, and planning backgrounds - working as consultants, or in local, regional and central government, research institutes and universities.

New members can sign up online.

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