rivers GROUP
A joint technical interest group of IPENZ & Water NZ

Issue 6: August 2011 ISSN 1179-674X

INSIDE THIS ISSUE

EMERGING PERSPECTIVES IN RIVER SCIENCE AND MANAGEMENT

Presented by Professor Gary Brierley and Associate Professor Stephen Coleman

When and where
9.30am–4.00pm Friday 23 September
Greater Wellington Regional Council
142 Wakefield St
Wellington
Cost
$345 including GST
To register visit the IPENZ website.
For more information:
profdevadvisor@ipenz.org.nz or phone (04) 474 8984.

How we manage our rivers is of major importance to our society and the economy. Water resources management is an increasingly contested space, subject to increasing pressures and stressors.

This short course will overview emerging approaches to our understanding of river systems along with practical management implications. Emphasis will be placed on cross-scalar issues from geomorphic and engineering approaches to analysis of river dynamics.

This course is of relevance to those interested in river dynamics and river management: from those living with dynamic rivers to river and resource managers, planners, environmental practitioners, consultants, students and academics.

Topics to be covered include:

- Values framing river management
- Scales of consideration
- Fluvial hydrodynamic and sediment processes
- River morphology
- Connectivity and sensitivity
- Templates for river management
- River classification and its significance
- Understanding and interpreting evolution trajectories. ≈

Hurunui River, North Canterbury

FROM THE CHAIR

Stephen Coleman, Chairman of the Rivers Group

On behalf of the Rivers Group Committee, we hope that this newsletter finds you all well and looking forward to a refreshing Spring season.

It has been a busy time behind the scenes for the Committee. After completing involvement in the Auckland-based Stormwater Conference, Culvert workshop and presentation on the Brisbane floods in March, we've progressed arrangements for a series of workshops across New Zealand, begun organising our annual symposium, held a planning retreat to refocus the committee for the coming year, upgraded the website and worked to complete this newsletter. A number of these activities are highlighted further in the newsletter.

In terms of the website, we've freshened the look and made it more live in terms of photo variations and more-frequently updated items. If you have any photos that you'd like to see as part of the changing webpage banner, then please send these through to riversgroup@ipenz.org.nz. Under the "Links" tab on

the website (http://www.ipenz.org.nz/riversgroup/Links.cfm), we now provide a collation of recent news articles about rivers that is updated approximately weekly. It really is interesting to read the range of river-related matters going on in our world, and to reflect on the significance of rivers in our lives. More recent news articles are also highlighted on the home webpage. I'd encourage you to have a look at the selections of these frequently-updated news tidbits that are now available on the webpage.

The committee planning day focused on themes of value, leadership and facilitation. Particular avenues where we aim to increase our focus this year include strengthening regional activities, addressing needs of interest groups such as recreational and river-user groups, and leading workshops and document preparation on technical matters of contemporary significance. We continue to invite ideas from the membership as to possible themes or events that they'd like to see the Rivers Group co-ordinate. Check our website for information updates as they arise, and be sure to let us know of potential future activities and articles that we can distribute further to the group membership.

In terms of the AGM to be held along with the annual symposium in December, we are presently seeking expressions of interest for people who may want to serve on the Rivers Group Committee. You can see the present committee at http://www.ipenz.org.nz/riversgroup/Committee.cfm, where about one-third of the committee will be stepping down this year. If you are interested in getting involved, please send an email to riversgroup@ipenz.org.nz. We'd love to hear from you and have you be part of growing the group to be of value to our membership, rivers users throughout New Zealand, and also society in general. We are particularly looking for a person who will be able to take over editorship of the newsletter, so if that is of interest, then please let us know.

We look forward to seeing you at our annual symposium and the AGM in Wellington.

Nau Mai, Haere Mai. ≈

Waimakariri River Braids from the Air

SEWAGE OVERFLOWS IN CHRISTCHURCH'S ICONIC RIVERS

Shelley McMurtrie, Aquatic Scientist, EOS Ecology
www.eosecology.co.nz

The 22 February and 13 June 2011 earthquakes will remain in the memory of Christchurch as perhaps the most traumatic experience of our generation. Below the surface of the city's rivers the impact was no less severe, with inputs of liquefaction sand/silt, bank slumping, uplifting of streambeds, and inputs of raw wastewater from a broken and crippled sewerage infrastructure. Following the February and June earthquakes around 50 000 m^3 of raw sewage entered the city's rivers on a daily basis. The tireless work of City Council staff and contractors soon reduced this level to 20,000 m^3/day within the ensuing months, but almost 10,000 m^3/day of sewage continues to enter the rivers as ongoing tremors and heavy snow falls hinder the repair to the city's infrastructure. Inputs of untreated human waste into surface waterways is thankfully no longer the norm in New Zealand, and thus the scale of the inputs and knowledge of their effects was relatively unprecedented and warranted investigation. The amount and duration of sewage inputs entering the lower non-wadeable portion of the Avon and Heathcote Rivers following the February earthquake led the Christchurch City Council to commission a study on the impact on the river's inhabitants. With little pre-earthquake data on the lower non-wadeable portions of the rivers (traditionally a no-go area for most freshwater surveys programmes due to the difficulty of sampling) a bioassay experiment was decided as the best means to initially determine the level of impact to the rivers' aquatic inhabitants.

Removing invertebrate bioassay cages in the Avon River upstream of sewage inputs

Approximately 2.5 months after the February earthquake, the EOS Ecology crew housed specimens of *Paracalliope*, *Potamopyrgus*, and *Paratya* in cages in the Avon and Heathcote Rivers at a site upstream (control) and downstream (impact) of sewage discharges, and checked their survival after 2, 6, and 12 days. During the 12 day experiment there was an estimated daily overflow volume of 4,800 m^3/day of raw sewage to the Avon River upstream of the impact site, with the nearest regular discharge 1 km upstream and an intermittent discharge 150 m upstream of this site. On the Heathcote River 2,700 m^3/day discharged from one overflow point, approximately 1 km upstream of the impact site.

Survival of all three species was not significantly lower at the downstream site on the Heathcote River, but there was a decrease in survival of Paracalliope and Potamopyrgus at the downstream site on the Avon River over time. Survival of Paracalliope dropped to around 60% at the downstream impact site after six days, indicating a short-term susceptibility to the conditions. While survival continued to decrease after 12 days, a similar mortality spike at the upstream control site indicated cage

effects weighing in during this latter time period. At 10%, the mortality of Potamopyrgus over the 12 day period, while not as dramatic may indicate an impact on these snails over a longer period of time. The significantly lower dissolved oxygen levels and elevated ammonia levels at this site are the most likely cause of the decreased survival for these two species.

Removing invertebrate bioassay cages in the Avon River downstream of sewage inputs

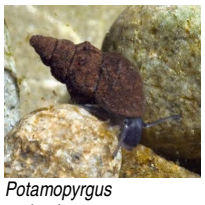
The dissolved oxygen levels at the downstream site were below the acute guideline value of 3 ppm for the duration of the 12 day experiment. Ammonia levels fluctuated widely at this site but at times reached levels greater than the concentration found to be toxic to at least Paracalliope and Potamopyrgus in laboratory studies. It is also probable that tolerance levels would be lower than what has been found in laboratory tests, given the long duration of the sewage overflows into the Avon and Heathcote Rivers (over two months at the time of the bioassay experiment).

The higher inputs of sewage during the first few weeks of the February earthquake (estimated at almost 35,000 m^3/day for the Avon River and 12,500 m^3/day for the Heathcote River three weeks after the quake) would have presumably created a more widespread die-off of invertebrate fauna. However, the lower inputs of sewage that was continuing to discharge into the Avon River over two months after the February earthquake still appears to have been sufficient to cause problems for more sensitive invertebrates such as the amphipod Paracalliope, and for species typically regarded as being more hardy, such as the snail Potamopyrgus. Given the duration of the overflows, which currently stands at six months, invertebrates remaining in the lower reaches of both rivers may well be exposed to chronic (sub-lethal) effects, with long-term impacts such as increased susceptibility to disease, impaired reproduction, and altered biotic interactions. With the most recent 13 June 2011 earthquake the sewage inputs to the Heathcote and Avon Rivers returned to similar levels as for the days following the 22 February earthquake, putting additional pressure on a system already stressed from months of sewage overflows.

Raw sewage being pumped into the Avon River

Removing bioassay cages from the downstream impact site in the Avon River

We can probably all agree that while the sewage inputs remain there is going to be an impact on the fauna in the lower reaches of our much loved rivers. The interesting question is what can we do about this? Providing some level of re-oxygenation is tricky to realise in such large, deep, and slow flowing rivers. Diverting the sewage overflows to 'somewhere else' is certainly not an option - the choice between sewage backing up in the streets or peoples' back yards versus overflowing to the nearest waterway is an easy one to make if it is your back yard that is going to become a poo pond. In this regard we can be thankful that Christchurch is able to avoid the human health implications of sewage in the streets and should reflect on yet another unquantified ecosystem service our waterways provide. So in some cases all we can do is watch and wait, and use this time to gain as much understanding as we can as to the effect on, and eventual recovery of, these systems. ≈



Potamopyrgus antipodarum

Paracalliope fluviatilis

Paratya curvirostris

EARTHQUAKE DAMAGE TO WAIMAKARIRI RIVER STOPBANKS

Ian Heslop, Environment Canterbury

The September 2010 and February 2011earthquakes damaged half of the 18 kilometre Waimakariri and Kaiapoi River stopbank length downstream of the Northern Motorway.

After the first quake the design stopbank flood capacity of 4,700 cumecs (450 year return period) was substantially reduced, and Environment Canterbury set a target to restore the flood capacity to 3,000 cumecs (30 year return period) by Christmas, before the “nor-westerly” flood season.

Fortunately the repairs progressed to target, as on December the 28th a 2,500 cumec flood was successfully contained, which otherwise may have flooded parts of Kaiapoi and the outskirts of Christchurch.

Most of the September quake repairs were completed before the February quake, which caused less significant damage in the same general areas. Repair costs for the September quake were $3m, with an additional $2.0m required for the February quake.

Stopbank damage was typically settlement (300 to 500 mm), longitudinal cracking, base spreading, and foundation cracking - due to the high ground acceleration, and liquefaction or lateral spread of the foundations.

Damage seemed more dependent on foundation conditions, and close proximity to old and existing river channels, than to construction methods or materials. Poorly consolidated sand/silt foundations with a high water table were the most common culprit, as they are very prone to liquefaction and lateral spread.

Brian McIndoe, Environment Canterbury Area Engineer responsible for coordinating the repairs, was very pleased with progress. "The effort put in by ECan staff and contractors was exceptional, and it is very satisfying to see the work completed to both programme and budget."

Brian cautioned however that stopbank performance during future floods needed to be monitored closely, as there can be no guarantee that all the stopbank cracks have been identified and satisfactorily repaired. ≈

MANAPOURI HYDRO POWER SYSTEM MODELLING

Hugh MacMurray, Barnett & MacMurray Ltd

The Manapouri power station owned by Meridian Energy Ltd is the largest hydro power station in New Zealand in terms of maximum output, producing 840MW at full load. Lake Te Anau has a surface area of 352km^2, making it significantly larger than Lake Wakatipu and the second largest lake in New Zealand. Its water level is approximately 202m above mean sea level. Lake Manapouri has a surface area of approximately 140km^2, and its water level is about 178m above mean sea level. Manapouri power station is located underground at the end of the west arm of the lake, and its tailrace tunnel discharges to Deep Cove, at the head of Doubtful Sound. The power station discharge at full load is 550m^3/s. Much of the station output is used to supply the Tiwai Point aluminium smelter, which normally draws 560MW of power.

The levels of both lakes are managed according to strict environmental guidelines, which are designed to keep the lake levels, and the fluctuations of lake levels, within the range that would have occurred naturally. Lake levels are managed by the gated structures at Te Anau Lake Control (at the outlet of Lake Te Anau to the Upper Waiau River), and Manapouri Lake Control which is on the Waiau River just downstream of the Mararoa River confluence, about 11km downstream of the lake outlet.

Manapouri Lake Control

The Waiau River downstream of Manapouri Lake Control suffered a drastic drop in mean flow with the construction of the power scheme. Under present resource consent conditions a minimum flow of 12-16m^3/s (depending on the month) is maintained, and the mean annual maximum flow over the last 20 years is 558m^3/s, compared with a mean flow under natural conditions of approximately 400m^3/s. With the occurrence of Didymo in the Waiau River, and for other environmental reasons, the release of substantial flushing flows at Manapouri Lake Control is desirable. One of the main purposes of the modelling project undertaken by Barnett & MacMurray Ltd was to provide a system for determining how much flushing flow could be provided under given lake level and inflow conditions.

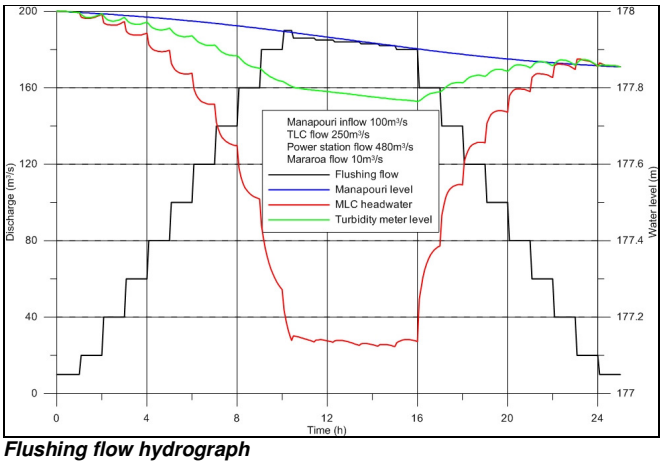
The current trial flushing flow regime calls for a hydrograph with a peak flow of 160-250m^3/s, with a mean flow over 24 hours of

120m^3/s. In addition the ramping rate is limited to 20m^3/s per hour. The volume of such a hydrograph is equivalent to just a few centimeters change of water level over the combined area of Lakes Manapouri and Te Anau, and therefore if hydrograph volume were the only concern, flushing flows could be delivered relatively frequently. The difficulty however is in delivering the water through the Waiau Arm (that part of the Waiau River upstream of Manapouri Lake Control).

The upper part of the Waiau Arm is deep and has low resistance to flow, but in the kilometre upstream of Manapouri Lake Control, it is affected by sediment from the Mararoa River. The resulting much shallower reach can limit the flow at Manapouri Lake Control, particularly when higher flow rates are required with lower lake levels. In such cases the gates are lifted clear of the water, and the discharge is determined by the resistance to flow of the Waiau Arm and the river downstream of the control structure. The flushing flow model was designed to include this case.

A model of the entire system was built using the AULOS software, and the Waiau Arm was calibrated by a continuous long term simulation from 1990 to 2010. More emphasis was placed on more recent years, because of the gradual sedimentation of the reach immediately upstream of Manapouri Lake Control. A model version without the control structure, but with present day river geometry, was used to simulate some high flow events. It was found that the sedimentation of the Waiau Arm by Mararoa sediments had significantly reduced the outflow capacity of the lake, by comparing model results with the last known natural rating. This is not surprising considering the change in mean and peak flows in the Waiau River, but it does affect the ability to deliver the desired flushing flows.

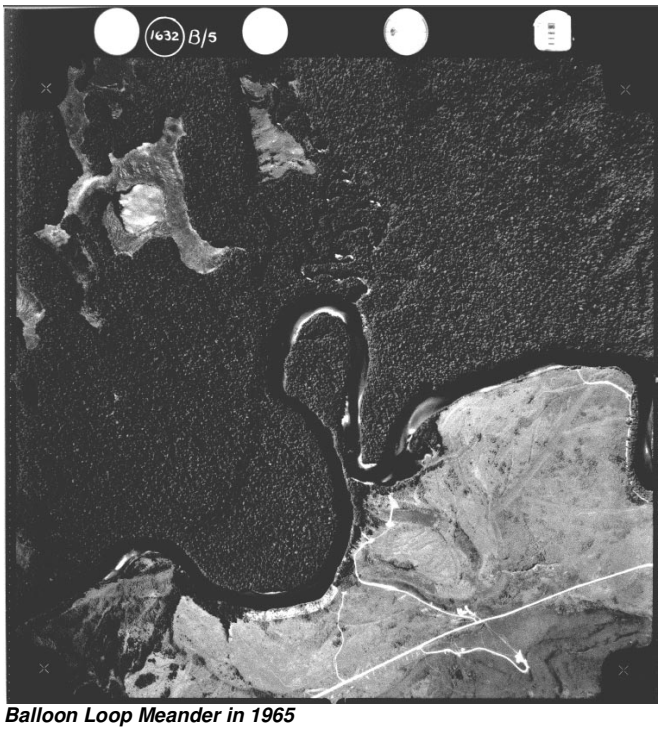
The flushing flow model uses the interactive mode of the AULOS software, in which the user sets a brief pause on each time step, and so can stop the model and change boundary conditions at will. Thus forecast lake inflows can be applied, and the effect of various flow settings at Te Anau Lake Control and the power station can be tested. The discharge at Manapouri Lake Control is stepped up by 20m^3/s per hour until the rating table shows that the gates would come clear of the water. At that point the user must manage the flow settings to be consistent with the resistance to flow of the river, which is not difficult after some practice. A flushing flow hydrograph for a test case is shown below.



Flushing flow hydrograph

The turbidity meter, where water level is also recorded, is just upstream of the reach affected by sedimentation from the Mararoa River, and about 1km upstream of the Manapouri Lake Control gates. The large water level difference required to drive the flow over this last kilometer of the Waiau Arm may be seen. The model also shows the transient response of the system to sudden changes in flow at the control structure.

The Upper Waiau River, which delivers flow from Lake Te Anau to Lake Manapouri, has a generally stable bed of large cobble to boulder sized material. However there has been a meander cutoff since the 1960s. The figure below shows an aerial photo taken in 1965, showing that at that time the river flowed around the Balloon Loop. The second figure below shows a view from true left to true right across the meander cutoff, taken in 2011, and the third figure shows the Balloon Loop from the Kepler Track in 2011, showing substantial sedimentation of the old loop, presumably with material from the Forest Burn. It is likely that the effects of the meander cutoff on bed levels are still in progress.



Balloon Loop Meander in 1965

Meander Cutoff, 2011

Sedimented Balloon Loop, 2011 ≈

RIVERS GROUP 2ND ANNUAL SYMPOSIUM 2011

Reflecting on the future

When: Monday 5 December 2011
Where: Mac's Function Centre, Shed 22, corner of Taranaki and Cable Streets on the Wellington Waterfront

The second Annual Rivers Group Symposium will be held in Wellington on Monday 5 December 2011, with the day of stimulating discussion by invited speakers followed by the opportunity to socialise with other Rivers Group members.

The symposium will run from 08:30 through to 17:45, with an optional social function and dinner following. A discount on attendance fee is offered to current Rivers Group Members, and there will be an opportunity for new members to sign up.

The event will involve presentations by invited speakers and the Rivers Group Annual General Meeting will also be held in the afternoon. The keynote presentation will be given by Professor Tim Davies from the Department of Geological Sciences, University of Canterbury, and entitled "Floods: not just cumecs". This will explore the interaction between floods and river geomorphology.

Other invited presentations will cover flood vulnerability in the face of possible future climate change effects, the historical impacts on people of floods in the Hutt River and the effects of past river management practices, case studies on the rehabilitation and restoration of rivers and streams in the Hawke's Bay, Manawatu and Wellington Regions, and cultural health monitoring of streams. We are also hopeful that we can get someone from the insurance industry to provide an insurance perspective on managing future flood risks.

There will be representatives from local, regional and central government as well as practitioners, consultants, contractors, iwi, and interest groups.

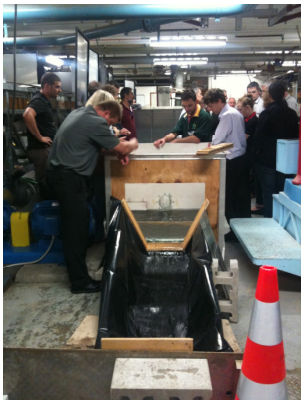
Sponsorship opportunities for the symposium are available. Please contact the current committee if you would like to follow up on any such opportunities.

With our event scheduled to dovetail with the 50th New Zealand Hydrological Society Conference, registrants will have the option of attending both events, and/or the Friday field trips to either Lake Wairarapa or the Hutt Valley and Waiwhetu Stream.

Registration for the Rivers Group 2nd Annual Symposium will be opened soon, and will be done via the IPENZ web page.

For information on the 50th New Zealand Hydrological Society Conference and the field trips including cost, see http://www.nzhsconference.co.nz/.

To register for the field trips contact Mike Thompson on mike.thompson@gw.govt.nz or telephone 04 830 4239. ≈



THE CANTERBURY EARTHQUAKES AND OUR RIVERS

RIVERS GROUP / IPENZ CANTERBURY BRANCH PRESENTATION

When: Drinks / Nibbles from 17.00 and presentation 17.30 onwards, Wed 21/09/11
Where: University of Canterbury, Engineering Common Room & E5

Objective
Presentation to Rivers Group, WaterNZ and IPENZ Canterbury Branch members on the effect that the Canterbury Earthquakes had on our local rivers, the immediate response and the long term plans. Rivers discussed include: Halswell, Heathcote, Avon, Styx , Waimakariri and Kaiapoi.

Topics to include:

- The basics: Where are our rivers and what are their tributaries/catchment areas?
- What condition were they in pre-earthquakes (incl. flora/fauna)?
- How were they being maintained?
- What effect did the earthquake have on them?
- What did we do immediately after the earthquakes and what are we doing now?
- What were/are we discharging to them and what effect is this having?
- What options do we have for their future?

Canterbury Rivers were significantly affected by the recent earthquakes. The local and regional authorities have a big job to assess the effects of the earthquakes, repair damaged infrastructure and plan a new future them. Come and learn more about the rivers during a presentation from two people whose work revolves around them: Ian Heslop (ECan) and Graham Harrington (CCC). Drinks and nibbles will be provided and no RSVP is required.

Time guide
Presentation, 40-50 mins
Q&A, up to 15 mins

Presenters:
Ian Heslop, Environment Canterbury (ECan)
Graham Harrington, Christchurch City Council (CCC)

MC: Tom Parsons, Rivers Group Committee Member ≈

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The views expressed in this newsletter are those of the individual authors and are not necessarily representative of the Rivers Group as a whole, nor of any of the individual or committee members.

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