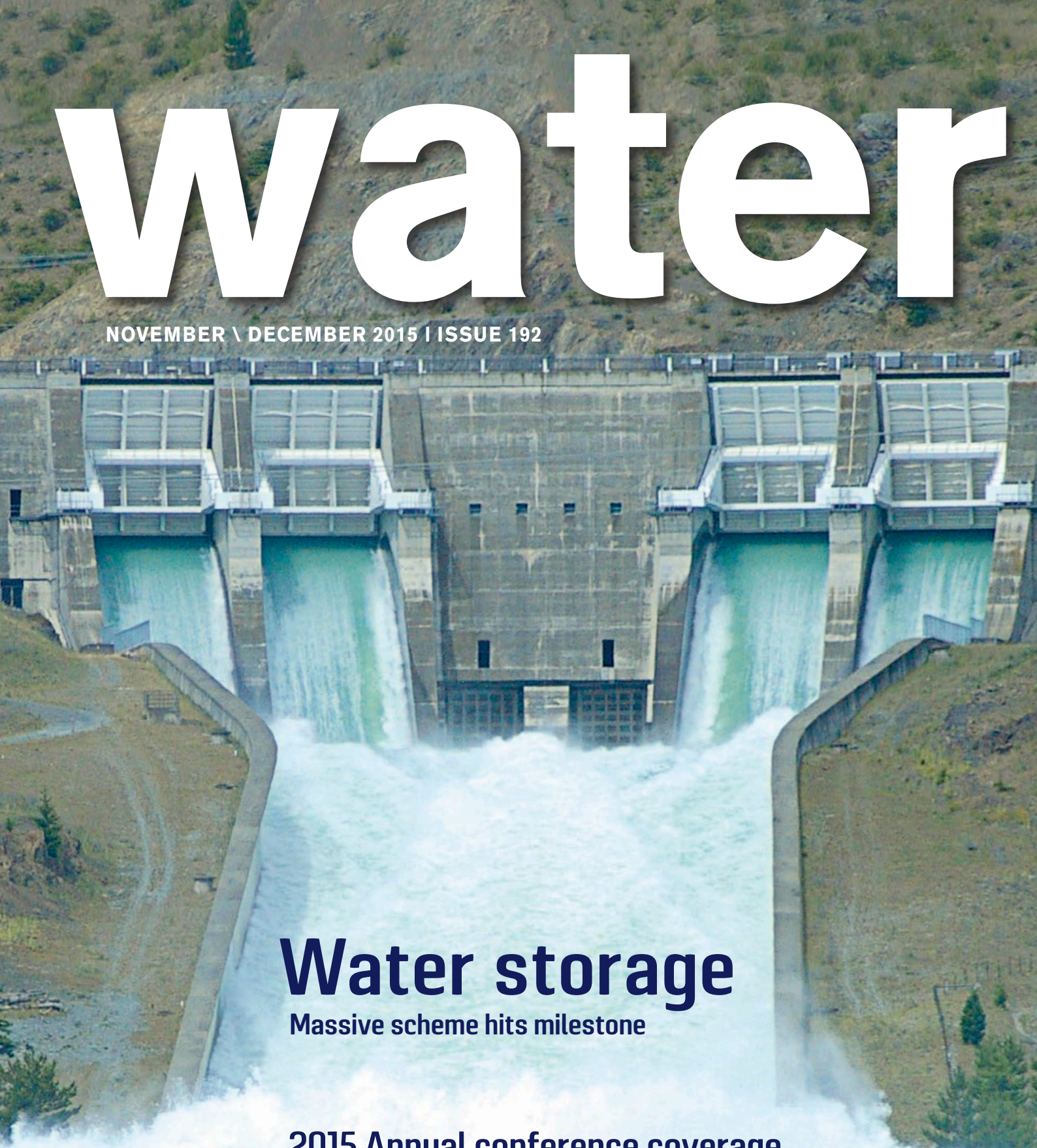
water

NOVEMBER \ DECEMBER 2015 | ISSUE 192



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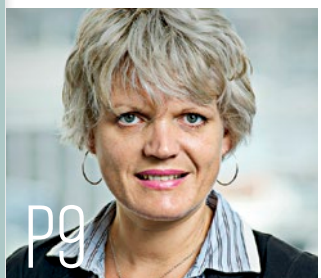
Issue 192 NOVEMBER/DECEMBER 2015

Inside

Features

Regulars



The official journal of Water New Zealand – New Zealand's only water environment periodical.
Established in 1958, Water New Zealand is a non-profit organisation.

Cover image: Vicki Jayne – Benmore Dam Spillway

LGNZ paper has a familiar ring

Brent Manning, President, Water New Zealand.

"It seems to me a duplication of effort to overlay what we have with a new regime."

The latest iteration of the Local Government New Zealand (LGNZ) led project on the state of the three waters is out, entitled, "*Improving New Zealand's water, wastewater and stormwater sector*". If you haven't read it yet you should. Here's a weblink to the report: **http://www.lgnz.co.nz/assets/29617-three-Waters-Position-Paper.pdf**

LGNZ is to be congratulated on the collation and analysis of considerable cross-sector data, and their conclusions along broad themes, most of which Water New Zealand has consistently identified through our own benchmarking over the past decade and institutional understanding through our membership.

To recap some main themes.

1. The three waters form a substantial part of New Zealand's infrastructure – up to $45 billion of an estimated LG asset base of $120 billion.
2. Three waters services are delivered to a diverse range of communities and interests – the forecast variability of population change (growth in some areas, decline in others) as well as demographic change as we Generation Xers age, will pose major challenges for us all.
3. The diversity of communities and customers supports the goal of consistently good outcomes across the three waters. There is plenty of evidence to show, though, that these outcomes are not being consistently delivered across the country. Greater customer engagement will be the key to ascertaining customer needs as distinguished from their expectations.

Overall, there is significant room for improvement in service delivery, be it from improved asset management practices and sharing of knowledge, better financial modelling and some form of regulation oversight. LGNZ advocates for "*a strong sector-led approach*".

Well newsflash – if you are reading this, then you are probably part of that sector.

The LGNZ paper proposes use of a new agency, the Local Government Risk Agency, currently being scoped, as a new local government-owned body to lead overall sector improvement and collect and maintain sector data and expertise.

They propose that this body's decisions on important sector issues would be empowered through a sector-wide multi-lateral commitment delivered either through a binding multilateral contract or a co-regulatory regime similar to that operating in the gas sector.

Such a regime would operate in direct competition with Water New Zealand's annual performance review (benchmarking) and in my view would need regulatory powers to enable it to deliver.

Water New Zealand has developed over many decades as an effective collaboration of water sector expertise and practitioners. Through our networks we have access to national and global expertise in the water sector. It seems to me a duplication of effort to overlay what we have with a new regime.

Nonetheless the report acknowledges that despite a collaborative model being "*appropriate to the sector... and less costly than full blown economic regulation that in itself does not foreclose moving to full economic regulation and that in itself should incentivise all parties to do their best to ensure the model's success*".

I don't think regulation in itself is anything to fear; there are many successful overseas jurisdictions in water where an independent economic regulator is vital to the ongoing performance of the sector – in addition most have a customer advocacy body as well. Either way it's clear that we all need to work together to meet the future challenges.

On a closing note, I wish through this column to acknowledge the very good work of all those staff, contractors, exhibitors, sponsors, speakers and delegates who made this year's annual conference in Hamilton, the success that it was.

My congratulations again to all award winners too. We won't rest on our laurels however, and will next month conduct a thorough review of what went well this year, and what can be further improved, including a possible expansion of the awards format, as we look forward to next year's conference in Rotorua in October. **WNZ**

Brent Manning, ***Water New Zealand President.***

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RUATANIWHA FACES FURTHER DELAYS

Hawke's Bay Regional Council's attempts to build a 7km-long irrigation reservoir near the foothills of the Ruahine Forest Park faces further delays with Forest & Bird announcing it will challenge a planned Department of Conservation land swap that would enable the project to go ahead.

The disputed swap involves 22ha of protected conservation land included in the 372ha that would be flooded by the scheme. DOC had agreed to swap the 22ha, which includes valued wetland and threatened flora and fauna, for a 170ha plot of private land containing beech forest and regenerating native bush. F&B has sought a High Court review of this decision

IrrigationNZ CEO Andrew Curtis has described the move as using "delay tactics" in an attempt to stall development of the Ruataniwha dam noting that DOC had run an open process of public consultation for the land swap in which F&B had participated.

He said it was essential to "keep the big picture top of mind" with infrastructure projects like Ruataniwha. "The focus must remain on the overall net gains for the Hawke's Bay region and its communities. With El Nino on the horizon and eastern New Zealand increasingly vulnerable to climatic fluctuations, the surety of water supply from Ruataniwha will provide net environmental and economic gains for all."

MAJOR BOOST FOR IRRIGATION IN CANTERBURY

With its first stage completed, the Central Plains Water scheme is now delivering water to 120 farms – irrigating around 20,000 hectares between the Rakaia and Hororata Rivers.

Officially opened by Primary Industries Minister Nathan Guy in August, stage one includes a 17km canal and 130km of pipeline. The work finished on time and came in only slightly over budget at $172 million.

Work is now underway on design and engaging consultants for stage 2 of the scheme which is planned as a three-stage development. When complete, Minister Guy said it was estimated to generate economic activity of between $1billion to $1.4 billion providing an export boost of $328 million across the Canterbury region and more than 1000 new jobs.

The Central Plains Water Enhancement Scheme will then irrigate 60,000 hectares of dairy, arable, horticulture and stock finishing land between the Rakaia and Waimakariri Rivers.

(See feature on page 18.)

INTENSE EL NINO PROMPTS WATER RESTRICTION WARNINGS

Dry conditions in the Tasman District have already prompted water restriction warnings; high winds recently put Otago on early high fire risk alert and farmers around the country are being told to prepare for what promises to be a severely dry summer.

These early signs bear out NIWA's prediction that New Zealand is on track for the "second most intense" El Nino weather pattern since 1950. This pattern generally means drier conditions in the north and east of the country and for many comes on top of an unusually dry winter.

Minister for Primary Industries Nathan Guy has urged farmers and growers to plan for possible El Nino conditions – including water restrictions – and his Ministry has issued a brochure outlining practical advice for how farmers can prepare for drier weather.

IrrigationNZ is also advising irrigating farmers that timing is vital and that they need to start the season well.

"Inefficient irrigation now will have a huge impact on whether your volume will see you through to March," warns CEO Andrew Curtis.

"Irrigation scheduling is central to this, particularly now irrigators are limited in the water they have through seasonal volumes. With water meters in place, irrigating farmers should be keeping a close eye on what they are using, regularly reviewing soil moisture levels and crop requirements and applying water efficiently as possible. Off the back of another dry winter there's no room for wastage or poor performance as every drop will be needed this summer. We recommend sitting down and planning your water budgets so you know exactly where you are at."

Alongside appropriate irrigation scheduling, checking irrigation equipment is well maintained and performing to specification will minimise down-time, leakage or delivery problems, says Curtis.

OPUS WINS $3 MILLION WATERPROOFING PROJECT

Opus International Consultants (Opus) has been awarded $3 million by the Ministry of Business, Innovation & Employment to undertake a research project to reduce annual maintenance and construction costs to water damaged roads.

The funding, over four years, will enable a team of researchers from Opus Research, the University of Auckland and the Australian ARRB Group to create and test a type of impermeable membrane that will prevent water from entering gravel layers and causing damage. The group will also look at ways to modify chip seals so there's less chance of them being damaged by water.

Opus Research Leader Peter Benfell says New Zealand's road network is highly susceptible to water damage with more than 90 percent constructed from chip seal construction and that new road surfacing technologies have good potential to both extend roading life and save millions in maintenance.

The government currently spends about $1.3 billion a year on road maintenance and up to a third of that is caused by water damage, says Benfell.

"Within 10 years, the success of this research could save the country as much as $80 million dollars a year."

ENVIRONMENT REPORT HIGHLIGHTS WATER QUALITY DECLINE

Declining water quality and increased nitrogen in rivers are identified as concerns in the recently released report Environment Aotearoa 2015.

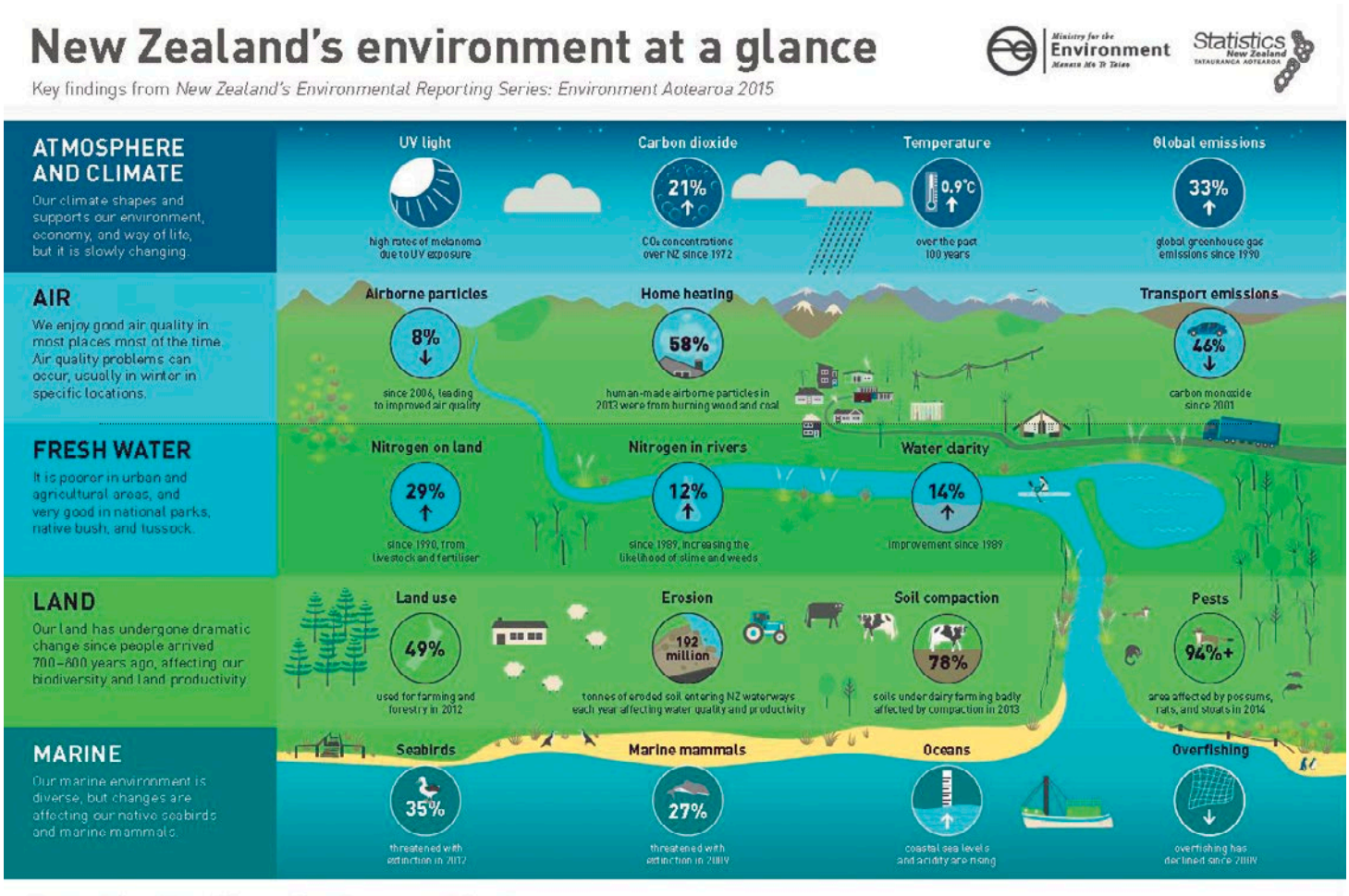
The first state of the environment report in eight years, released late last month by Statistics New Zealand and the Ministry for the Environment, found both river and soil quality was impacted by farming activities. It reports that between 1989 and 2013, total nitrogen levels in rivers increased 12 percent with 60 percent of monitored sites showing statistically evident increases.

Nearly half of the monitored sites had enough nitrogen to trigger periphyton or algae growth which is identified as the biggest impact from excessive nutrient in the water. This growth is responsible for impeding water flows, blocking irrigation and water supply intakes and smothering riverbed habitats. It also affects the recreational use of water, the report said.

It found that water quality was good in areas with less intensive land use and indigenous vegetation.

While it showed improvements in areas such as air quality due in part to reduced carbon monoxide emissions from traffic, primary greenhouse gas emissions are still rising. Between 1990 and 2011, global net emissions gases rose by 33 percent while New Zealand's went up by 42 percent.

The report says that coastal sea levels and long-term sea-surface temperatures have risen over the past century and our oceans are more acidic than when measurements were first taken in 1998. Another major concern is species extinction with 80 percent of native birds, 88 percent of mammals and 100 percent of indigenous frogs under threat.



Tapping in to water news

Gisborne District Council and local iwi Ngati Porou last month approved a Joint Management Agreement that will enable them to jointly manage land and water within the Waiapu catchment. Mayor Meng Foon said the council recognises the fundamental role Ngati Porou have as kaitiaki. "In establishing a JMA, we will be the first in New Zealand to jointly share the function, power and duties under the Resource Management Act."

NZ Landcare Trust's Aorere River Project won the inaugural Morgan Foundation NZ Riverprize at last month's International Riversymposium in Brisbane in what Trust CEO Nick Edgar described as a real victory for community-led grassroots river management in New Zealand. The Aorere River Catchment is home to over 13,000 cows and 35 dairy farms and had suffered serious bacterial contamination. NZ Landcare Trust coordinated a clean-up effort that included a $1.6 million investment in best on-farm management practices.

Dunedin's historic Ross Creek Reservoir is on track for a refurbishment of the dam embankment with ground sampling starting last month. The dam, has been closely monitored since large cracks appeared five years ago. To date, this has included an irrigation system on the dam face and gradual lowering of the water level. This stage of the project involves creating a platform on the dam face. Opus has the contract for design and construction management for the dam refurbishment. Completed in 1867, but unused for 20 years, the Ross Creek Reservoir is the oldest large earth dam in the country.

A 30,000 litre water tank gained Facebook fame after it took off down SH73 near Darfield last month. High winds kept it bowling along at a good pace – a local truckie's video gained more than three million hits and much overseas interest.

The Westland Community will get a say on a proposal by Westland District Council and Westland Milk Products to partner on a $5 million upgrade to the Hokitika treatment plant. It's proposed the council would raise a five-year loan to fund the construction but recover 100 percent of that cost via a targeted water rate charged to Westland Milk Products which has a growing demand for high quality water.

The Tasman District Council is proposing a major stormwater upgrade to reduce the likelihood of a flood like that in April 2013 which saw local businesses inundated with water. The $13.9 million planned upgrade in central Richmond will include a new pressure pipeline, upgrades to the Queen St stormwater system and work to flatten out the surface of Queen Street. Work will be carried out in stages between 2016 and 2025.

RESILIENT STORMWATER SYSTEMS UNDER CONFERENCE SPOTLIGHT

The 2016 Stormwater Conference, scheduled to be held at the Rutherford Hotel in Nelson from 18-20 May 2016, will focus on "Resilient Stormwater Systems."

The main sub-themes are: Building Flood Resilient Communities; Sustaining and Valuing the Environment; Catchment and Asset Management Planning; and Governance, Regulation and Planning.

The technical sessions of the Conference will be on Wednesday 18 and Thursday 19, with optional site visits on Friday 20 May. The Welcome Function will be on the Wednesday night and the Conference Dinner on the Thursday night.

The conference also offers a prime opportunity to promote your organisation through sponsorship and exhibition.

For further information on the Conference, visit www.stormwaterconference.org.nz or email waternz@avenues.co.nz

FOCUS ON OTAGO IRRIGATION OPPORTUNITIES

The future for irrigating farms in Otago was under the spotlight at IrrigationNZ's first-ever AGM in the region on November 5. Both existing and potential irrigators were invited to attend a workshop ahead of the AGM.

IrrigationNZ CEO Andrew Curtis says the workshop covered how national policy is impacting irrigation in the regions, combined with how Otago irrigators can best equip themselves to benefit from this. The discussion was based on a recent report that IrrigationNZ commissioned outlining the challenges and opportunities facing Otago irrigators.

The AGM saw two long-serving board members, Ian McIndoe and Dan Bloomer standing down after contributing more than 15 years.

New to the board is Keri Johnstone – principal of Irricon Resource Solutions and a South Canterbury farmer who feels it's time for her "to contribute more publicly".

"Nutrient management is going to be a big challenge. People say we need to make more food but not at the expense of the environment – so it's about finding the balancing point and maintaining water quality. It's an interesting challenge. It's about us using water wisely, making it go further and managing nutrients," says Johnstone.

CALL FOR CONTESTABILITY IN WATER PROVISION

A recently released report from the Productivity Commission on *Using Land for Housing* identifies shortcomings in the current governance arrangements for water infrastructure that, it says, are "likely to inhibit affordable and efficient provision".

It notes that governments in other countries have sought to increase the scale of water provision through mergers of existing providers. While this can deliver scale economies and capability gains, it hasn't always led to increased efficiency.

Public provision monopoly is also questioned and the report suggests legislative barriers to the use of contracting arrangements for water services should be repealed to create greater contestability in water provision. It advocates amending the Local Government Act 2002 to provide councils with a wider range of options for providing and managing water services.

The full report can be accessed at www.productivity.govt.nz

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With a strong focus on recycling, next year's IFAT – the world's leading trade fair for water, sewage, waste and raw materials management will be showcasing new solutions for treating industrial water to recover reusable materials.

The water sector is traditionally a broad-based sector at IFAT and this includes industrial water – which represents a major proportion of water consumption in industrialised nations.

The chemicals, metals and mining industries all require large quantities of water for their production operations. Treating fresh and process water, handling cooling water and wastewater, recycling water flows and recovering the reusable materials that they often contain continue to give the international environmental-technology industry an enormous field for marketing new and established solutions.

These latest innnovations and technologies will be available at the upcoming IFAT which takes place in Munich from May 30 to June 3, 2016.
See www.ifat.de./index-2.html

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OPTIMISING OUR WATER VALUE

WATER NEW ZEALAND'S ANNUAL CONFERENCE & EXPO

Peter Whitehouse sums up a successful three days at the Water New Zealand Annual Conference.

Hamilton's Claudelands Event Centre was the venue for Water New Zealand's Annual Conference and, yet again, it proved to be a great success.

Six streams of papers, four workshop sessions and a sold-out exhibition proved to be a crowd pleaser – and what a crowd. Well over 1000 bodies came through the doors over the course of the three days and they all took something of value from the event. Iwi rights and interests were a feature of the opening sessions and certainly stimulated some interesting discussions. A workshop on a potential water CCO for the Waikato region also featured on the Wednesday morning, as did presentations on water infrastructure funding offering both Australian and United Kingdom perspectives.

Understandably, a number of papers addressed resilience issues and a workshop on Thursday addressing the same issue was very well attended (see separate report in this issue).

On the social side, Wednesday evening was the time for the Project Max Welcome reception, the Jeff Booth Consulting Modelling Dinner and the Applied Instruments Operations Dinner.

Thursday morning opened with a stimulating keynote presentation from Australian Lucia Cade again exploring infrastructure planning, funding and delivery (See page 34). Along with technical presentations. Thursday also featured the aforementioned resilience workshop and two others – one concerning renewals and performance standards and the other discussing Water New Zealand's National Performance Review.

Thursday evening marked the premier social event with the Hawkins Conference Dinner and Awards, and entertainment provided by the remarkable Music Island Boys. Eight awards, highlighting various aspects of excellence in the industry, were made and general indications were that the evening was viewed as a very enjoyable occasion.

Friday's programme featured a new initiative. Once the Water New Zealand AGM was completed, delegates were treated to an amusing and fascinating session with Australian motivator and magician, Vinh Giang.

Following brunch, the session continued with two well respected figures in the industry, Dr Terry Heiler, from the National Infrastructure Advisory Board, and Mark Christison, discussing a range of water related issues.

At the conference closure, Rotorua was announced as the 2016 venue with tentative dates of 18-20 September.

All in all, another very professional and well-run conference – and thanks must go to Avenues Event Management and MC Frankie Stevens. Similarly, thanks must go to the 'under pinners' of the conference, our Premier Sponsors – Applied Instruments, City Care, Downer, Hynds, Transfield Services and Xylem.

But at the end of the day a successful conference is about people so Water New Zealand thanks all those presenters, delegates, expo personnel and our hardworking Technical Committee who all contributed to make it the success it was – well done. **WNZ**

WNZ BOARD WELCOMES NEW MEMBERS

Water New Zealand's two new board members Dukessa Blackburn-Huettner and Vijesh Chandra are both Auckland based and have expertise in stormwater management.

Dukessa Blackburn-Huettner (below) is manager Stormwater Operations for Auckland Council – responsible for managing and maintaining the Auckland Stormwater network, estimated at $4 billion and serving a third of New Zealand's population. A chartered professional engineer, she brings over 15 years water industry experience to the role. This includes experience in leading planning, development, operation and management of mainly three waters infrastructure, initially through consulting both in New Zealand and Europe, and then local government. She has served on the Water New Zealand Technical Committee for seven years, three years as its Chair. This is her second term on the Board.

Vijesh Chandra (right) is business leader, stormwater for GHD whose other roles include Liveable Cities and Communities Advisor. A chartered professional civil engineer, he has 25 years of experience in local government infrastructure management. Vijesh has played a key part in winning the International Water Association project innovation honour award 2012, IPENZ Arthur Mead award for the environment and sustainability 2001 and the New Zealand Engineering Excellence award for Environmental Practice 2012. He is also a Trustee of the National Wetland Trust and has been a Practice Area Assessor for IPENZ for more than 10 years. As a Board member, Vijesh is keen on making a real difference to the profile of the Stormwater industry in NZ, to Water New Zealand's profile nationally and internationally and to NZ's economy and environment. This is his first term on the Board.

The 2015/2016 Board are: Brent Manning – President; Hugh Blake-Manson; Kelvin Hill; David Simpson; Dukessa Blackburn-Huettner; and Vijesh Chandra

Congratulations to members Raveen Jaduram, Robert Blakemore, and Bruce Porteous, all of whom were made Honorary Life Members of the Association at the AGM.

CELEBRATING Water New Zealand AWARD WINNERS

It was the highlight of Water New Zealand's recent conference – a glittering evening at the Claudelands Events Centre celebrated high achievers from across the industry.

Winner of the IXOM Operations Prize is Alistair Forsyth of Wellington Water who designed and built a high-pressure water cleaning system that solved some difficult problems in the plant and will be used for future bore cleaning.

The Mott MacDonald Poster of the Year was awarded to Lee Bint for *Commercial Rainwater & Greywater Feasibility: preliminary findings* which looked at the challenges of integrating rainwater harvest and grey water re-use systems in commercial buildings. The poster demonstrated examples throughout New Zealand where buildings are successfully using this technology.

The Ronald Hicks Memorial Award went to Rainer Hoffmann from MWH, with Stuart Hildreth and Christopher Salkeld from Sicon Ferguson for joint authorship of *New Zealand's First Full-Scale Biosolids Solar Drying Facility* – Selwyn District Council's wastewater treatment plant in Canterbury.

Aaron Green collected Opus Trainee of the Year Award. A senior water treatment operator working at Downer NZ in Southland, he impressed supervisors with his work ethic, good humour and initiative in looking for on-site cost savings and process improvements.

The new CH2M Beca Young Water Professional of the Year is Matthew Ewen from Filtec Technology whose focus on research and development has led to the design of new products that both give his company export offerings and reduce reliance on large offshore providers.

Jules Scott-Hanson earned ProjectMax Young Author of the Year for relating a "well prepared paper that held audience attention and culminated in clear and articulate responses to the questions raised". Her paper is *An Innovative Approach to Conditional and Damage Assessment of Land Drainage Assets*.

The Hynds Paper of the Year Gold Award went to Martin Neale from Golder Associates for *Re-Engineering Urban Streams: The Effects of Daylighting on Stream Ecology*. The Silver Award was earned by Clare Houlbrooke for *Managed Aquifer Recharge in Poverty Bay* and Rob Darby won Bronze for *Boring Injection Inoculates Against Expensive Upgrades*. (See p42 for the winning papers.)

The Water New Zealand Awards Dinner

ProjectMax Young Author of the Year Award Jules Scott-Hansen with, from left, WNZ CEO John Pfahlert, ProjectMax director Blair Telfer and WNZ President Brent Manning.

Lee Bint is the proud winner of the Mott MacDonald Poster of The Year.

Rainer Hoffman with his Ronald Hicks Memorial Award.

IXOM Operations Prize winner Alistair Forsyth, Wellington Water is congratulated by WNZ president Brent Manning.

Rob Darby – winner of the Hynds Paper of the Year Bronze Award.

Opus Trainee of the Year Award winner Aaron Green from Downer NZ with WNZ President Brent Manning, Luke Meys (Opus) and WNZ CEO John Pfahlert.

CH2M Beca Young Water Professional of the Year Matthew Ewen from Filtec Technology.

THANK YOU TO OUR PREMIER SPONSORS

Water New Zealand would like to thank the six premier sponsors for their continued support for the Annual Conference & Expo. Water New Zealand is grateful for their tangible support, advise and input in planning the conference and expo.

Representatives for the six premier sponsors are from left to right:
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IN AND AROUND THE WNZ CONFERENCE

1


2


3

4


5


6

1. At the Downer stand: Chris Jobson, Tom Swindells, Hamish Mills and Neil Smart.
2. Award winner Jules Scott-Hansen.
3. Hugh Blake-Manson (WNZ), Peter Higgs (IPWEA), Braden Austin (Palmerston North DC), and Robert Blakemore (Wellington Water).
4. In the exhibition hall.
5. Barry Somers (Far North DC), Allen Ingles (Aecom), Kathryn Collie (Aecom), Greg Preston (University of Canterbury), and Sioban Hartwell (Aecom).
6. Eldon Tate with Octavio Perez Garcia.
7. Keynote speaker Vinh Giang.
8. WNZ President Brent Manning with some familiar faces.
9. Keynote speaker Rahui Papa.
10. Gary Pugh (Arthur D Riley & Co) with John Pfahlert (WNZ).

7


8

9


10

EXHIBITOR AWARDS

Single Stand First Place was won by Liquipro and Single Stand runner up was awarded to Apex Environmental. The Multi-Stand Winner was Asmuss Water Systems with the Pipe and Infrastructure stand taking Runner-Up.

Asmuss Water Systems Darrell Tonge and Ross Buddle with their Best Exhibition Multi-Stand Award.

Liquipro's Peni Peleti is awarded the Exhibitors Best Single Stand by WNZ President Brent Manning.

Apex Environmental's Elizabeth Van Beek is presented with Single Stand Exhibitor Runner Up award.

The Pipe and Infrastructure stand earned Multi-Stand runner up.

Rivers RULE HER LIFE

Donna Flavell counts herself very lucky to be participating in the Treaty of Waitangi claims process as historic changes are taking place. She talks to **Vicki Jayne** about iwi's role in protecting freshwater health.

A childhood spent beside the Waikato set the course for Donna Flavell's career focus in more ways than one. Not only does the spirit of the river flow through her Waikato-Tainui iwi's veins but her hometown of Ngaruawahia is also home to the Maori Kingitanga – and was at the centre of 1980s tribal renaissance.

"I was at the high school there at a time when there was a lot of political debate around the Treaty of Waitangi. It was a time of massive land marches and major precedents like the Coalcorp case. The Government was wanting to sell assets and Maori were saying that we have rights and interests that need to be observed.

"There was also a serious push for Maori language recognition, the Treaty was really coming to life – and I just happened to be in the middle of it because a lot of that debate was happening around Turangawaewae Marae."

Those lively debates were what informed her decision to study law.

"It helped prompt an interest in the Treaty and in assisting whanau to address some of our issues and claims. Not so much in the sense of flag waving but in terms of the need to create our own destiny – to get past the grievance and do something about it. It's not up to the Crown to determine what that looks like. It's up to us. Only we can take ownership and leadership in that.

"I think that kind of conversation really resonated with me. That if we want to get out of the rut we were in, then only we can make that change and that difference."

She headed off to law school – and her first post-grad job saw her back in the Waikato working with the late Sir Robert Te Kotahi Mahuta researching her iwi's claims.

"[Sir Robert] was a big influence on me – in terms of our people taking leadership in thinking about what the future looks like for us."

For Waikato-Tainui, that future was very much informed by the past – and their relationship with the river. It is, explains Flavell, like a tupuna (ancestor) which possesses its own spirit – one that is inextricably linked to tribal mana and life force. That means iwi health and wellbeing depends on the river's health and wellbeing. Improving the latter is very much part of iwi focus when it comes to freshwater management.

But getting to a point where iwi could have any influence on that has been a long haul – and started ages before Flavell was born.

"The conversation around our claims started generations ago. When confiscation first happened after the Land Wars, our leadership sought redress for grievances around both land and water. So this has been a long ambition and I was lucky enough to do the formal research around that – straight out of law school."

After that work was finished, she moved down to Wellington for a job in the Ministry of Justice. But a few years after the passing of Sir Robert Mahuta, she was asked to come back to help with the Waikato River claim.

While the river had originally been part of the 1995 Waikato Raupatu Claims Settlement, the Crown at that stage had only been offering the river bed, she explains. That didn't wash with tribal elders.

"For Waikato-Tainui, the river is much more than the bed. So we had decided to separate that part of the claim out and save it for another day. For me, it was like all the stars aligned because I was able to go back and build on the research I had started under Sir Robert."

Further years of work culminated in the 2008 Deed of Settlement which not only acknowledged the iwi's unique relationship with the river but, more importantly, ensured ongoing input into how the river was managed. That means the tribal vision of restoring their river's health and wellbeing could be realised, says Flavell.

She is, she says, incredibly lucky that such an important milestone happened during her watch.

"Some people don't get to do any of that in their entire lifetime."

The crux of what was a complex claim rests on two key principles, says Flavell.

"One is Mana whakahaere which recognises that the tribe has its own relationship with the river and that has existed for generations. Part of that is about care and nurture. We recognise the river as tupuna – an ancestor – in whose best interests our actions take place."

"I think that kind of conversation really resonated with me. That if we want to get out of the rut we were in, then only we can make that change and that difference."

It's not just about Kaitiakitanga or guardianship, she says, but is inextricably linked with ancestral relationships, the connections between different river iwi and the sense of mutual care and responsibility they all hold for the river's spirit and mana.

"It's really about getting back to that place where we can have more say in what is happening to the river and that what we

are doing is in the best interests of the river. It's based on the recognition that if Iwi care for the river, then it will continue to sustain the people.

"It enables our people to be part of that – utilising the river, celebrating the river, all those things that the relationship entails."

The other primary principle, Te mana o te awa, is about respecting the spiritual authority, protective power and prestige of the Waikato River – something that is at the heart of the relationship between iwi and their river.

"That is about the river itself and so water quality issues are paramount."

It's not, as some people mistakenly believe, about ownership, says Flavell.

"You can't own your parent – this is not in an ownership place – but we do want to have all these different relationships with our awa, whether it's economic development, collecting kai, bathing, swimming, paddling waka or blessing ourselves with the water. It's all of those relationships."

Building on those principles are various mechanisms such as the Waikato River Authority – a co-governance body established between the Crown and Waikato River iwi to restore the river's health.

"So those are about keeping those fundamental beliefs intact in a more contemporary way – creating the vision and strategy to achieve that – and it's changed the way we operate in our region. That's because the local authority has always said they are a statutory body that must only do what the law tells us to. So we had to change the law and the only way to do that was through settlement."

It doesn't amount to a major change in how things are done – but it does ensure that iwi are included in decisions that affect water use and the potential impacts on water quality, she says.

"We recognise the river as tupuna in whose best interests our actions take place."

Through the Freshwater Iwi Leaders Group (ILG), Flavell is now involved in giving these same principles a nation-wide application. While not usurping the mana of individual iwi to engage directly with regards their own water bodies, the ILG is lobbying at both government and regional level for greater iwi involvement in the allocation, use and protection of freshwater sources throughout the country.

Its objectives range from enabling formal recognition of iwi/hapu/whanau relationships with particular freshwater bodies – and addressing uncertainty of supply of potable water on all marae – to enhancing iwi participation at all levels of freshwater decision-making. It also aims to develop mechanisms that will give effect to iwi values in maintaining

and improving freshwater quality as well as enabling iwi to access freshwater resources in order to realise and express their economic interests.

The legislative landscape has already undergone some major changes. Just last year, an agreement between Whanganui iwi and the Crown produced a legal first when the river was given its own legal identity.

"Having their river recognised as a person with its own legal rights is incredible," says Flavell. "The trick is how to ensure all the activity happening around [a freshwater body] is going to work in its best interests.

"That's the same challenge we face in our settlement. We want the same outcome to ensure that the health and wellbeing of our river is paramount and we should all be working together to ensure that.

"So even sitting at the table, all the hats we represent should come off and everyone should represent what is in the best interest of the river. That is the challenge in the implementation stage for both Waikato and Whanganui."

Flavell is now on secondment from Waikato to work with Ngai Tahu as the iwi's general manager strategy and influence – and is enjoying what she describes as some very productive information sharing.

"Ngai Tahu is always doing amazing things and I guess one of the reasons I came here is to learn more about governance. They have been very generous with me in terms of sharing information – I love being able to look at how other iwi are being innovative across the board in terms of tribal development generally, not just water.

"But while I'm here, I'm hoping to assist them in terms of what I know. So there's learning on both sides. I think this is the first time this has been done and it's such an honour for me to be here and for them to be so open and sharing – they are great people with great leadership."

The mother of four has already seen many positive changes for her own and other iwi and is still enjoying the sort of political debates that first fuelled her career choice back in the 1980s. With the oldest of her own children now studying law at Waikato, her own excitement in her chosen career hasn't dimmed.

"What I like most about my work is the range of issues and of relationships. A lot of the work I do is around supporting key leaders in key political engagement as a governance group. So I really enjoy the relationships with other iwi and key stakeholder groups – the people side of things."

Each tribal group may have their own way of doing things – but their aims, she notes, are similar.

"We want the same thing but just have a slightly different pathway to achieving it."

And as well as learning more about how another iwi operates its affairs, she is also learning more about Aotearoa.

"It's great getting to know more about the landscapes down in the South. As a North Islander, I had no idea just how big their area is. So there's some real learning going on there as well." **WNZ**

Massive scheme hits first milestone

The Central Plains Water Scheme is a landmark project in New Zealand – and an inspiring project to be involved with. Aecom's market service director for water resources and Headrace Design Project manager **Sioban Hartwell** outlines some of the challenges of the recently opened first stage.

Fifteen months after the first soil was turned, water has filled the 17km-long canal, marking the commission of Stage 1 of the Central Plains Water (CPW) scheme. This was officially opened by Prime Minister John Key in mid-August, with water available, on target, to shareholders at the beginning of September.

It is a significant milestone in the history of this landmark project. The scheme is one of the country's biggest earthmoving projects in recent years, with relatively short time frame targets set for completion. However, it's been in the pipeline for some years and has negotiated a number of hurdles. The concept was first introduced in 1999, with a feasibility study completed in the early 2000s. It was April last year before the first stage of construction got underway.

There's no doubt this project is unique; the time to completion is short and the scale large. Rather than being constraints, these factors inspired and motivated the design team. They worked closely with CPW's own small team enabling CPW to realise its vision of providing reliable and cost effective water to the Central Plains.

Reliable water gives agriculture predictability, a necessity for a region where the industry is the economy's biggest driver. Irrigated farmland generates around three times the level of production of an equivalent non-irrigated area. Stage 1 of the scheme will irrigate approximately 20,000 hectares of the Canterbury Plains, drawing water from the Rakaia River.

Thirteen bridges have been built.

When complete, the scheme will have the capacity to irrigate some 60,000 hectares of Mid-Canterbury farmland between the Rakaia and Waimakariri Rivers. The result could be up to an extra billion dollars injected into the local community.

Regulatory Requirements

The headrace canal is classified as a dam under the Building Act 2004, because of the volume of water it retains and its depth. As such, it is required to be classified and attain a building consent. The Stage 1 headrace holds about 1.2 Mm^3 of water.

The Building Act requires the impact of failure for a dam, or each reach of a canal, to be assessed and a Potential Impact Classification (PIC) assigned. CPW's headrace and sedimentation pond embankment were assessed by AECOM, who rated the PIC as low.

Resource Consents and Landowner Agreements

CPW has all the necessary Resource Consents, a journey which began in 2001, with all required consents finally granted in July 2012.

A designation for the CPW headrace is set in the Selwyn District Plan. The alignment of the headrace canal has been amended in the process of optimising earthworks for construction and also to take into account the requirements of individual landowners. Thus, while in general the canal is still located within the designation set for the canal, the alignment deviates in some locations from that originally consented.

Alignment changes are primarily associated with the

FIGURE 1 – EXTENT OF STAGE 1

The Stage 1 Headrace Canal system comprises a two-kilometre intake channel, three gated intake structures, a sedimentation pond, infiltration gallery (fish barrier), header pond and a 16.7km long headrace canal, which has four main offtake structures and a number of minor offtakes.

In just 18 months, more than 3Mm^3 of material has been excavated and placed as either engineered fill or waste to form the canal. Somewhere in the order of 550,000 m^2 of High Density Polyethylene liner has been installed and 13 bridges have been built.

The Stage 1 headrace is supplemented by an extensive distribution network; a piped system transferring water from the four headrace offtake structures in the headrace canal to the farm gates.

Fulton Hogan has led the construction of the headrace, with an army of sub-contractors to assist. Downer has constructed the extensive distribution network.

avoidance of, or integration with, irrigation pivots. As such, the alignment has been fitted around the outer wheel in a number of locations to avoid moving pivots.

Placement of waste material also had to be agreed with each landowner. Due to the length of the scheme, shifting waste material was a significant cost and, wherever practical, waste disposal has been adjacent to the cut. In many cases this has been achieved by localised raising of paddocks.

Headrace Design Basis

The Stage 1 design capacity for the canal is 14.4m^3/s, however design had to account for the full future required capacity of 33 m^3/s.

The basis of the headrace design is that there is no slope, allowing water to be fed from both the Waimakariri River and the Rakaia River. The canal follows the 235 metre 'reduced level' contour – the target normal operating water level. Flow is generated by draw off from the offtakes, rather than a slope on the canal base – operating more like a reservoir than a conventional canal. Velocities were limited to 1m/s or less in order to protect the HDPE liner and prevent uplift.

The liner system was adopted following site investigations. Analysis of materials had shown that the compacted earth lining would not meet performance criteria for leakage and embankment stability due to the lack of fines in the natural materials available.

2. Water fills the 17 kilometre canal.
3. Dunfield invert placement.
4. Headrace.

Construction Challenges

While a majestic location, the canal site brings a unique set of challenges. These include weather conditions, the need to maintain farm operations throughout and the site's physical location.

High winds caused some delays. When the nor-wester hit, placement of liner was not possible. That meant crews were required to work extended hours when the wind calmed. At the tail end of the construction phase, snow and sub-zero temperatures created their own set of challenges.

With access to some farms closed during critical periods, like lambing season, the construction programme could not assume a linear construction front.

In practise, many work fronts running concurrently were required to progress according to the programme alongside embankment construction, cut sections and liner placement all at their construction peaks.

Most of the workforce travelled daily to the site, which is about an hour's drive from Christchurch. Adding travel to a long working day meant that one of the challenges for all contractors and CPW staff was managing fatigue and keeping staff safe on the drive to the site. With black ice through winter, this involved delaying travel on several days until the roads were safe to drive.

Jessica Newland, a graduate graduate civil engineer with AECOM, carried out construction monitoring for the Central Plains Water Headrace and was impressed by the project's sheer scale.

"CPW is an irrigation project on a scale not seen before in New Zealand. My main role was to carry out the QA for the installation of the HDPE liner. It was not without its challenges but the experience it gave me has been invaluable and is something that will aid my future career as a design engineer.

"It's projects like this that AECOM undertakes that attracted me to the firm. Being on site in such a beautiful part of the country was just an added bonus."

On the day the canal was filled there was a great sense of pride amongst the CPWL team, contractors and designers - and relief too that this milestone had been accomplished.

Now, with construction of Stage 1 complete, the focus turns to future stages. CPWL has commenced concept design for Stage 2 with the target for prospectus issue in April 2016. **WNZ**

UNIQUE CHALLENGES

While a majestic location, the canal site brings a unique set of challenges. These include weather conditions, the need to maintain farm operations throughout and the site's physical location.

RAROTONGA PROJECT boosts water storage

Te Mato Vai is the largest infrastructure initiative undertaken by the Cook Islands – GHD business development manager **Steve Carne** outlines the project and how it will improve supplies of healthy water to the island.

The Te Mato Vai water supply project in Rarotonga in the Cook Islands is the first shared development initiative between the governments of The Cook Islands, New Zealand and People's Republic of China.

It aims to deliver healthy water to communities within Rarotonga. As part of the National Sustainable Development Plan for the Cook Islands, the Te Mato Vai initiative is aimed at achieving significant growth in national public health, environmental benefits and more prosperity and economic growth for Rarotonga.

GHD was engaged by the Cook Islands Ministry of Finance and Economic Management (MFEM) to develop the design for much of the proposed new water supply infrastructure.

Te Mato Vai is the largest infrastructure initiative ever undertaken by the Cook Islands and will deliver a high standard new water network, including improved treatment, storage capacity and pipleines.

Existing system details

Rarotonga's existing water supply network is supplied by 12 separate spring and stream-fed surface water intakes located between 49m and 8m above mean sea level. The intakes are positioned around the island as shown in Figure 1 (page 24) with details as shown in Table 1. Water is supplied as "run-of-the-river" from all sources and flows purely by gravity to two ring mains that circumnavigate the island.

The ring mains were built in the 1960s and 1970s and connected pre-existing village supplies around the island. The oldest of the intakes (Avana and Totokoitu) are approximately 50 years old, with construction or upgrade of other intakes made in the early 1990's.

Flows in the associated streams at all intakes are highly variable by season and maximum and minimum recorded flows at each intake are also shown in Table 1.

Treatment of the raw water is limited and involves only the removal of gross solids through the gravel filters that form part of the intake systems. Raw water turbidities spike at least 25-fold regularly during rainfall events.

Currently there is no disinfection of water on the existing public system, although many commercial users, resorts and hotels have their own on-site treatment systems, including disinfection. It has also been estimated that approximately 1000 people a year seek medical attention from the effects of water-borne illnesses.

Water demand

Current and future water demand design data was derived using existing meter data, both on the trunk supply system and a selection of domestic and commercial meters that currently exist within the network. Demand and leakage assessments were made and were found to be highly variable based on seasonal influences. With domestic demand estimated to vary between 300 and 600 l/person/day, system leakage was estimated to contribute between 30 and 50 percent of total system demand.

On the basis of the above, lower bound estimates of future demand were assessed as ranging from 4200 m^3/day (based on a 200l/person/day target domestic consumption rate and a 20 percent leakage target) to over 15,000m^3/day based on current demand and leakage rates with additional agricultural demand.

Existing storages

There are nine reservoir or tank storages of various sizes in the existing supply network. These are also shown on Figure 1 and total only approximately 3500m^3 in volume.

Research carried out early in this consultancy indicated that a number of the hotels and resorts that have their own on-site storage reservoirs. It is understood that these are fed on demand by open valves at each of these connection points. Water is then treated at these resorts using on-site treatment systems prior to being pumped into the resort reticulation. Total storage volume within the resorts in approximately 5800m^3.

In 2013, MFEM introduced a subsidy scheme that encouraged the installation of domestic water tanks.

It is understood that the intent was for the tanks to capture rainwater to supplement the main supply sources for non-potable uses.

Approximately 1000 tanks of standard volume six m^3 each have been installed thus far. There are sufficient funds in the subsidy allocation to install approximately 2000 more tanks that will

INTAKE	CATCHMENT AREA	ELEVATION (RL)	INTAKE TYPE	MAX YIELD[1] (ML/D)	MIN YIELD[1] (ML/D)
Avana	243	81	Direct	3.40	1.27
Avatiu	135	80	In-stream gravel filter screen	1.67	0.47
Matavera	83	65	Offline with gravel filter screen	1.37	0.33
Muriavai	144	64	Direct	0.76	0.0
Ngatoe	98	65	Offline with gravel filter screen	2.0	0.23
Papua	163	49	Direct	2.02	1.20
Rutaki	109	51	In-stream gravel filter screen	1.84	0.34
Taipara	84	49.5	In-stream gravel filter screen	2.18	2.00
Takuvaine	161	69	Direct and In-stream gravel filter screen	2.94	0.67
Totokoitu	70	65	Direct	1.93	0.42
Tupapa	101	65	Offline with gravel filter screen	1.23	0.28
Turangi	118	72	In-stream gravel filter screen	3.68	1.98
TOTAL				**25.02**	**9.19**

Table 1. Intake Data Summary

result in a total of 12,000 m^3 additional storage in the system.

However, anecdotal evidence suggests that most tanks have been directly connected to the supply network. They are understood to fill on demand and hence act as buffer storage that will flatten out peaks in diurnal demand patterns.

Depending on the demand projections adopted, this indicates that at current estimated domestic demand and leakage rates, there is only 1-1.5 days' peak day demand storage within the network.

Rainfall variability

Historically, rainfall has been variable over Rarotonga and depends significantly on location. Figure 2 (page 24) shows total average annual rainfall contours.

Average annual rainfall varies from up to four metres in the Turangi and Avana catchments to 2m in the north western part of the island. Sources in the south-east of the island (Avana, Papua and Totokoitu) are therefore considered to be far more reliable than the northern sources.

Network operation

The existing supply network is operated by splitting it into six different supply sectors. These are shown in Figure 3 (page 24). The existing ring main system is limited in its ability to transfer water around the island to mitigate the localised effects of source supply failures.

The variable reliability of rainfall sources, system leakage assessed in the range of 30-50 percent, high levels of demand (estimated at up to 600l/p/day) and very limited network storage volume mean that low pressures and supply

Figure 1. Network Overview Raro Water Supply - Pipeline Distribution Reservoirs

Figure 2. Average rainfal l patterns

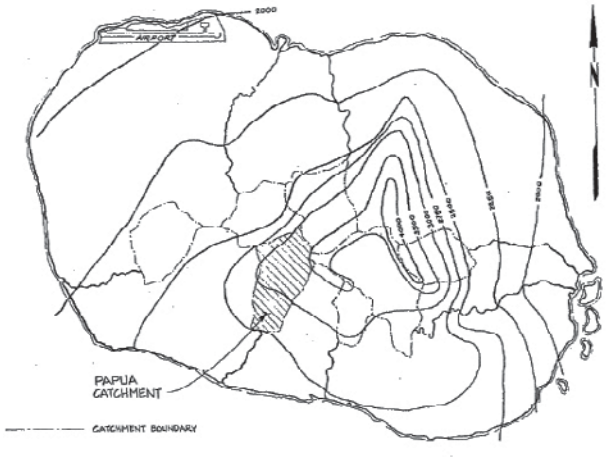


Figure 3. Existing operational water supply sectors

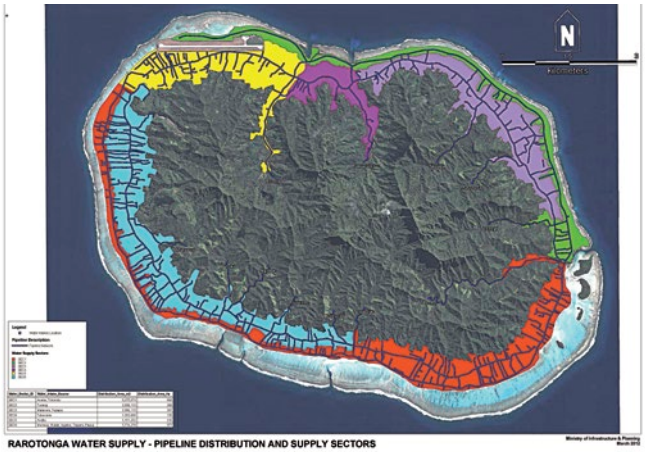
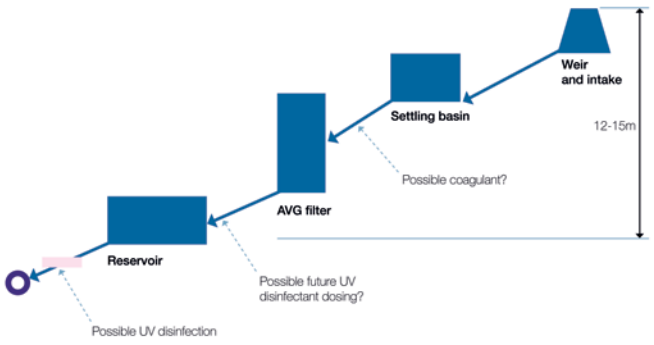


Figure 4. Treatment process schematic



failures in the system are not uncommon, particularly in the summer months.

This is particularly the case in the north-western part of the island which is furthest from the more reliable water sources in the south east part of the island.

Target performance criteria

The target network performance standards for the Te Mato Vai project are the following:

- The pressure in the network does not drop below 10m head. This is as per Infrastructure Cook Islands- Institute of Professional Engineers Cook Islands (ICI-IPECI) Technical Standards.
- The maximum network pressure does not exceed 60m head.
- Head loss per kilometre of pipe at peak flow does not exceed 3m head.
- Storage Availability – 1/3 Peak Day Demand as a minimum (as per the ICI-IPECI Technical Standards.)
- Fire Flows – 12.5 l/s at average day demand and 10m residual head (as per the ICI-IPECI Technical Standards).
- 200 litres/person/day domestic demand (as per the ICI-IPECI Technical Standards).
- 20 percent leakage (as per the ICI-IPECI Technical Standards).

It is acknowledged that significant progress from current levels to the last two of these target performance standards will rely on a sustained and targeted demand management and non-revenue water reduction campaigns.

Proposed infrastructure

The ring main system is currently being replaced by a new larger diameter inner and outer ring main system. This system has been designed by and is almost finished being constructed by the China Civil Engineering Construction Corporation. This ring main is designed to permit greater transferability of water from one side of the island to the other to better cater for variable local source reliability.

GHD's scope of work includes upgrade (where necessary) of feeder mains connecting the intake sources to the ring mains, upgraded intakes and the installation of treatment facilities and local reservoir storages at the intake sites.

Storages

On the basis of the above design criteria and consideration of available storage volumes on site, proposed reservoir storage volumes across the network total 21,300m3 and are distributed across nine of the intake sites.

Criteria in deciding the proposed reservoir storage volumes include:

- Maximum volumes possible at the particular sites;
- Meeting the desired target storage volumes of one peak day's demand

arising from the various modelled scenarios;

- A desire to rationalise the different storage volumes being built so as to modularise the reservoir layouts; and
- The proposed storage results in a total of approximately 40,000m3 of storage in the system.

This represents nearly 4-10 days supply at peak day demand, depending on whether the upper or lower bound design scenario is considered. This is a considerable improvement from current level of service associated with these criteria.

However, the absence of a larger impoundment storage or groundwater source of many months' demand volume means that even with the reliability improvements arising from Te Mato Vai, in more extreme seasonal weather patterns, the risk of supply failure still exists, albeit well reduced from current levels.

Treatment

Proposed treatment facilities total a peak capacity of 22,700m3/day and are distributed across 10 sites.

It was considered essential that given the remote location of most of the intake sites, that simple, gravity-fed, reliable storage and treatment systems were desirable, to not only reduce capital and operational cost but also to encourage long-term sustainable operation by ICI..

Criteria in deciding the proposed treatment facilities capacities include:

- Maximum available yields at each site;
- Consideration of the ranges of peak day demands arising from the modelling scenarios; and
- A desire to rationalise the number of different design capacities so that treatment facilities can be modularised efficiently.

On this basis, as shown in Figure 4, the likely type of treatment facilities proposed at each intake indicates that the bottom water level of any proposed reservoir needed to be approximately 12-15 metres below the level of the intake for full gravity flow function.

Implementation strategy

With construction of the upgraded ring mains nearing completion, all proposed intake, reservoir storage, treatment and feeder main pipework is planned to be carried out under a single supply and construction contract. Procurement of this contract is currently on-going.

A two-year construction period starting early in 2016 is planned.

- *Steve Carne has more than 25 years' experience in the water sector in Australia and New Zealand.*

Water, water everywhere

The case for irrigation

Andrew Curtis, Irrigation New Zealand CEO explains why reliable water should be our number one priority – despite fluctuating dairy prices.

Some people may be wondering how large regional-scale water storage and irrigation projects are still viable in the face of the recent blip in dairy prices. The truth is a reliable water supply for irrigation couldn't be more valuable than in the sort of commodity price downturn we have been experiencing.

Access to a reliable water supply provides an opportunity for farmers to grow more grass per hectare – the most cost-effective form of feed for pastoral farmers. Alternatively a reliable water supply will help farmers diversify their production, growing high value crops within their dairy platform for example.

Reliability also benefits the environment. Being able to apply irrigation as and when the plant requires it enables more efficient nutrient use, minimising leaching and run off whilst allowing production to remain competitive.

More diverse and efficient farm systems are key to a more stable local economy. Communities don't end up reeling every time a particular product is out of market favour. Water creates opportunity and options – it makes for a more stable economic environment.

The squeeze on dairy means that new irrigators are looking to alternatives and with our national horticultural production exceeding $7 billion, it is now proving a significant competitor to dairy.

But horticulture needs access to reliable water even more than dairy – you can't move a crop once it's in the ground!

That is what has triggered the development of the Ruataniwha water storage project in Hawke's Bay, which has a climate for producing world-class fruit, vegetables and wine. More stored water and more reliable access to water will make these local industries boom.

There are naysayers who constantly berate the developers of Ruataniwha. But one only needs to look at Canterbury to see how large-scale irrigation schemes can successfully get up and running to provide shareholders with water and unlock the land's potential while at the same time address environmental legacy issues.

Significant progress

August saw the official opening of stage 1 of New Zealand's largest co-operative irrigation scheme (potentially 60,000

hectares) for some years – Central Plains Water. Getting this significant project over the line shows that this country is able to get big, regional-scale water infrastructure funded and built.

It is very reassuring that the project met its deadlines and was constructed within 18 months with 100 percent compliance on its environmental conditions. It satisfied regulators, it got financing and all of the pieces were successfully pulled together to make it a reality. It was a huge hurdle to overcome, some would say unnecessarily so, but it shows that other water storage and irrigation infrastructure projects can be done.

Ruataniwha has around 60 percent of the required users signed up with a further 40 percent coming in, so momentum is building.

The Wairarapa Water Use Project has moved into its full feasibility phase – geotechnical studies and a better understanding of demand.

The Hunter Downs Irrigation Scheme (South Canterbury) has had the required buy-in from shareholders for the final stages of feasibility.

The Hurunui Water Project is now awaiting a high court hearing following a bizarre ruling by the Environment Court judge post its successful mediation. None of these projects have put on the brakes because there is a slump in dairy.

There is even more of a compelling argument now to get farmers to buy in to developing these schemes or to getting investors on board. Now is the time for the country to forge ahead with a diverse agricultural and value-add economy. We are in a perfect position to do this - a temperate climate, lots of rainwater to shore up for the dry season and booming consumer markets like China, Malaysia and Indonesia on our doorsteps.

More diverse and efficient farm systems are key to a more stable local economy.

The time for forging ahead with more water storage and irrigation infrastructure is now. We need to get on and do it with legislative and regulatory clarity as well as financial assistance from central and regional government to back what is an obvious solution to rallying our dwindling regional economies. **WNZ**

Irrigation snapshot

A new report from IrrigationNZ is designed to provide a window on existing and planned irrigation projects - CEO **Andrew Curtis** explains.

Next month, IrrigationNZ will produce its very first Irrigation Snapshot. The purpose of this annual report is to provide a transparent window on irrigation – where we irrigate, what proposed future developments are planned, how much water we use, what it is taken for and the value this creates for our nation.

Alongside this, the Irrigation Snapshot will highlight the significant investment continually being made in irrigation efficiency and the benefits this creates for the environment. Investing in modern technologies means our farmers use less water, can minimise the impacts of land use, whilst increasing the value of production. These are investments and benefits not to be sneezed at.

Our irrigated area is presently estimated at 750,000 hectares. In addition there is another 300,000ha of potential growth that could be sustainably achieved by 2025. While the majority of irrigation currently is in Canterbury, we have lots of emerging irrigation schemes in other regions around the country. Demand for reliable irrigation water is becoming more widespread.

Currently, we only abstracts around two percent of its water resource (if hydropower is included, this rises to about five percent) and irrigation accounts for approximately 60 percent of this. By international standards, our abstraction rate is extremely low which shows that New Zealand is a water-rich country.

Irrigation typically accounts for between 50 percent and 70 percent of water use internationally. This is because plants, in comparison to human drinking water needs, require a lot more water to survive and grow.

Pastoral-based activities make up approximately three quarters of our irrigated area (dairy 50 percent and sheep and beef finishing 25 percent). The other 25 percent of irrigation supports predominately vegetable and arable crops alongside fruit and wine growing.

New Zealand's irrigated area of arable and horticultural production is expanding. However, its growth is limited by the need for a highly reliable water supply. This requires investment in water storage or groundwater recharge projects, harvesting water during the winter and spring time to minimise the abstraction pressure on rivers during the summer.

In 2012, it was estimated that irrigated farms provided a $2.7 billion contribution to the economy, and more than double this in terms of the benefits to the wider community.

Irrigated agriculture underpins many of the provincial economies on the East Coast. Towns like Hastings, Blenheim, Ashburton, Timaru, Oamaru, Cromwell and Alexandra would be far less vibrant and resilient without irrigation.

Water provides a unique opportunity. If we could sustainably harvest another one percent of our abundant water resource, we would significantly grow the wider economy.

Providing high reliability to existing water users whilst growing the irrigated area needs to be our focus. Stored water could also solve most of the historical water quality and future climate change challenges facing eastern New Zealand, either through augmenting river flows during the summer or recharging aquifers in the spring.

Much of regional New Zealand's future success is reliant on community water infrastructure developments that create wins for both the economy and environment. **WNZ**

Using water wisely

IrrigationNZ chair **Nicky Hyslop** outlines the organisation's role.

Water is a subject that many of us are very passionate about. At IrrigationNZ, we are committed to helping our members and their service industries use their water wisely with the utmost regard for the environment.

Irrigators have long considered themselves to be stewards of the land and accept that, with increasing land use intensity, water abstraction needs to leave enough water in our rivers and streams to maintain healthy aquatic ecosystems – and the impact of farming on the land needs to minimise its footprint. So what's happening in our industry?

Irrigation has seen significant changes over the past 30 years. There has been a massive investment in upgrading irrigation systems from flood to spray, and then again to modern spray (centre pivots and laterals), drip-tube and micro-sprinkler systems.

This change has seen irrigation efficiency improve by 50 percent in just over a generation. The information age has also brought about a rapid increase in technology. Irrigators now have real-time access to water meters, soil moisture sensors and variable application systems. This allows us to know exactly what we are applying and where, all controlled through our Smart Phones.

IrrigationNZ plays a significant role in ensuring our members always have access to good information on the range of tools and management practices they can implement to do the very best they can. This commitment is on-going as we continue to learn more through good science and research.

Training and professional development is another important role for IrrigationNZ, alongside delivering Irrigation Management workshops to over 500 people a year; we now offer nationally recognised qualifications in Design, Performance Assessment and Irrigation Management. This has been an exciting and significant milestone.

IrrigationNZ also has an important role working alongside policy makers to ensure that any regulations put in place are workable - they will allow irrigators to successfully manage their businesses within agreed community expectations. Ensuring we can provide good information to the public on what happens on an irrigated farm is another key role for IrrigationNZ.

We continually talk about the fortunate position New Zealand is in with an abundance of water. This may seem like an oxymoron when you consider the prolonged drought on the East Coast.

However, if the winter snow melt could be tapped through water storage, a reliable water supply could be provided with minimal impact. IrrigationNZ is committed to working with communities to investigate and then build multi-purpose water storage projects that provide benefits all. **WNZ**

• *Nicky Hyslop has been on the IrrigationNZ board for nearly five years and has been a registered farm management consultant for 20 years with Macfarlane Rural Business. In partnership with husband Jonty, she farms an intensive sheep, beef and arable fully irrigated property in South Canterbury.*

BUILDING WATER INFRASTRUCTURE RESILIENCE

Our Three Waters assets are not often given much public consideration until a natural disaster such as the Canterbury earthquake severely impacts their delivery. How best to plan for or mitigate such effects? Participants in a workshop run by Greg Preston (UC Quake Centre) and Philip MacFarlane (Opus Research) at the Water New Zealand conference had an opportunity to address that question.

The University of Canterbury Quake Centre in partnership with Opus and Water New Zealand launched the *Levels of Service Performance Measures for the Seismic Resilience of Three Waters Network Delivery* at a workshop during the Water New Zealand Conference in Hamilton in September this year.

Participants got a very hands-on experience of how the guidelines are designed to work – and how they can be used to build additional resilience into delivery systems ahead of a potential disaster.

The purpose of the guidelines is to define Levels of Service (LoS) that are suitable for stages of recovery from a seismic event and then to apply them to a process of improving the resilience to earthquakes of three waters delivery systems. Whilst focusing on seismic hazard, these guidelines are also applicable to other natural disasters.

Seismic resilience of a three waters network can be defined as the ability of the system to still operate effectively despite damage caused by an earthquake. This resilience may be due to the network's ability to absorb the energy with minimum damage or it may be due to the ability of the whole system to adapt rapidly to the changes caused by the event or events.

Ideally a system has the ability to be both tough and flexible. The system is not simply the physical assets but also incorporates the people and processes that are central to the delivery of the service.

The seismic resilience of a three waters delivery network needs to be carefully balanced with cost of building and maintaining such networks. Central to this balance is an understanding of the Levels of Service that the network delivers.

To this effect, the guidelines provide a framework to define the current or potential operating stage of any part, or parts, of a three waters network in the event of, or planning for, a significant earthquake.

Background

The potable, storm and waste water (three waters) assets of this country are rarely considered by the public until a natural disaster or major failure affects the service delivery.

Unfortunately, New Zealand is very prone to large natural hazards including earthquake, flood, landslide, and volcanic eruption. Planning for, and mitigating against, the effects of such disasters needs to be ingrained into the business as usual practices of asset management.

In respect to three waters networks, whilst relatively rare, earthquakes are by far the most damaging event. Fortunately, building seismic resilience into a network and its management processes has been shown to have significant beneficial impacts on the network resilience in many other situations.

Building a resilient three waters delivery service begins with a clear understanding of what service is expected to be delivered.

The first step in this process is defining Levels of Service (LoS) that are clearly communicated, understood and valued by the community that the system serves. It is upon this understanding that the service expectations, costs, risks and compromises can be agreed with a community.

This guidance document defines a framework of Levels of Service performance measures upon which this conversation can be based.

In 2014, the total replacement value of the three waters assets was estimated at about $45.2 billion. The wastewater network had the highest replacement value at around $17.8 billion, followed by drinking water assets at $16.2 billion and storm water at $11.2 billion (figures from Internal Affairs analysis of 2014 Local Authority Annual reports).

As these assets are upgraded or replaced, many difficult decisions will need to be made in respect to the

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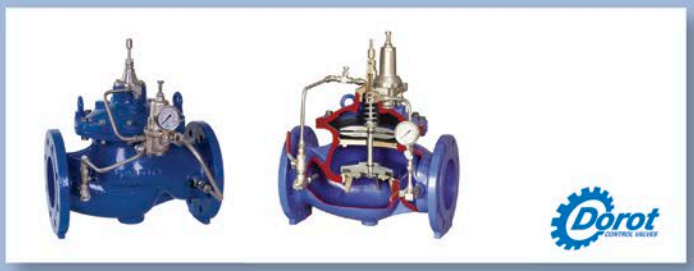

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1.


2.


3.

4.

1. Infrastructure Resilience Workshop participants take a hands-on look at mitigating the effects of a disaster.
2. Predicting operating stage zones – Greg Preston (left) facilitating.
3. Workshop co-presenter Philip Macfarlane from Opus Research.
4. Andrew Wedgner, Application marketing manager, Pipe for Borouge participates in the workshop.

trade-offs between Levels of Service, capital costs, operating costs and management of risk. One key lesson from the Canterbury earthquakes is that insurance cannot be relied upon as a sole risk mitigation strategy.

It is important that the argument for, and the cost of, seismic resilience is adequately understood, so that balanced judgements can be made in the investment and management of the Three Waters assets from a whole-of-life perspective.

It is also a requirement of the Local Government Act 2002 Amendment Act 2014 that territorial authorities have an infrastructure strategy that provides for resilience in regards to natural hazards.

Again, central to this is a discussion with the community as to the Levels of Service that are expected and how these levels are likely to be affected in the event of a natural disaster. This conversation needs to be framed in respect to the effect on the individual, the wider community, local business and the local and regional economies.

Why are these guidelines important?

The guidelines are designed to help build resilience into Three Waters Infrastructure by allowing a realistic discussion on what LoS can and cannot be expected if a seismic event occurs and therefore the risks a community carries.

This should inform the discussion between engineers, asset managers, the community and its leaders in regards to:

- Capital investment choices
- Maintenance decisions
- Insurance
- Other mitigation strategies

This discussion needs to be an iterative and ongoing process whereby the expected service levels can be balanced against the investment and resource demands of the network.

It may be that significant savings or resilience improvements may be made by changing the expected levels of service or by making systematic or community based changes to service delivery.

Alternatively, choosing to invest in improving key assets that ensure the provision of service to critical parts of the network may also be outputs of the iterative process. **WNZ**


Greg Preston


Philip McFarlane

• *Greg Preston is Education and Research manager at the University of Canterbury's Quake Centre and Philip McFarlane is Global Asset Management at Opus International Consultants.*

WHAT DO THE GUIDELINES CONTAIN?

The guidelines comprise a number of elements. At the highest level there are community based measures which are aimed at elected representative and members of residential and business communities.

These measures define service levels and targets pertaining to different operating stages, from normal (full) service down to the minimum, emergency, levels of service that may be expected shortly after an event.

The four operating stages defined reflect the stages of a system's recovery. These operating stages can be applied to several different service aspects from potable water quantity and quality to wastewater conveyance and to storm water treatment.

Overlaying these community measures is a hierarchy of critical services. Based on Maslow's Hierarchy of Needs, this looks at the provision of Three Water services to specific, user defined, community services in regards to a community's physical, safety and higher level needs. These are services such as hospitals, prisons, emergency centres, etc.

The combination of the community measures and the hierarchy of critical services provide input into Templates for Target LoS for critical services. These templates can be used to assist the process of planning for or managing a post-earthquake scenario.

WHAT CAN THE GUIDELINES BE USED FOR?

The Levels of Service Performance Measures for the Seismic Resilience of Three Waters Network Delivery are designed to be used in a number of ways:

- As a communication tool to explain the network status to communities and their leaders;
- As an aid to tracking recovery to normal Levels of Service after damage caused by a seismic event; and
- As a management tool to assist engineers and asset managers explain the investment needs to improve the resilience of networks.

Because each community has its own needs and priorities, the guidelines are designed to be flexible in their application. It is hoped that they will be a tool that enables and informs the community resilience discussion.

This discussion will need to be an iterative process through which Levels of Service and investment decisions can be made and weighed against each other.

RETHINKING WATER INFRASTRUCTURE

HOW WE PLAN THINK AND DELIVER

Crisis in the Murray-Darling basin prompted a major reform of Australia's water infrastructure – nearly three decades on, chair of Western Water Victoria **Lucia Cade** outlines progress and ongoing challenges.

The need to balance social, environmental and economic factors has been central to the process of water reform in Australia – and any conversation about water infrastructure planning needs to happen in the context of water's full value, Lucia Cade told delegates to the recent Water New Zealand conference in Hamilton.

It was crisis in the Murray-Darling basin – an area described as "Australia's food bowl" – that prompted a major reform process in the 1990s. At that stage, says Cade, the water was completely over allocated, the mouth of the river was silting up and there were no mechanisms for moving water to high-value uses.

"There was a lot of unmeasured water use and what you don't measure, you don't manage and you don't value. And that's inefficient. It meant that there was a poor return to the economy from water and there was environmental degradation."

Reform was conceived and driven by the whole concept of water as "economic enabler" and the need to balance social, environmental and economic factors, Cade says.

Various models were explored for moving to user pays and full cost recovery so water could be properly valued. There was also a strong focus on public consultation and education. But by 2004, while significant progress had been made, it was slow, says Cade.

The Government response in 2004 was to set up a national body – the National Water Commission with Ken Matthews as chair. It was to administer a A$1.8 billion fund to invest in water infrastructure and improved water resources management through the Water Smart Australia programme.

After a decade of implementation, Australia has come quite a long way – and now has "really robust" statutory water entitlements and planning in most states, says Cade. Water rights have been separated from land rights and can be used as collateral or security.

"In the drought, some farmers couldn't have survived if they hadn't been able to sell and trade their water rights – it's moving water to the highest value use, so that worked well."

Water plans are in place for all high-risk areas and over 80 percent of water is managed under water management plans. Caps are in place for over-extracted rivers and significant money is being spent upgrading river irrigation infrastructure.

"In the Murray-Darling, the irrigation system used to lose more water than the whole of Melbourne consumed in a year – so there's a lot being spent on reducing leakage," notes Cade.

In urban areas, in particular, pretty much everyone is now on some sort of user pays pricing.

"And the Commission is so successful that our last Prime Minister [Tony Abbott] decided it had done its job and disbanded it. So there is no Federal control over water. The challenge now for industry is to keep that momentum going. As industry people, we know not to waste the lull between droughts and that is harder without a national body."

Each of the states has different structures for managing their water resources and have experienced a range of different teething problems. "We have pretty much one of every model you can think of – so whatever model you're contemplating, come and have a look," Cade suggests.

Challenges ahead include increasing urbanisation.

"That affects Australia more than most – we have 15 million people in our capital cities and with increasing population growth and urbanisation, we are projecting a doubling of city populations by 2050. That's a huge challenge for water supply planning – providing enough and sharing it appropriately.

"We hope to do that without further stressing the environment. We have desalination plants in just about every major city - apart from Darwin and Canberra."

An extreme climate also means huge variability in water availability – and that makes managing consistency of supply a huge challenge. Responses include recycling where appropriate, stormwater utilisation, complementing storage dams with desalination plants and "taking a security through diversity approach to water supply".

Amongst opportunities to emerge, she says, is an increasing customer focus.

"Big utilities have had a practice of 'knowing best' but those days are now gone and most planning is very customer focused with different engagement models being used to include communities in decision making."

There's also more embrace of a "water balance mindset" – looking at how to value water in terms of recreational and amenity value. "We haven't quite figured out who pays – but recognising and quantifying that is half way there."

The conversation around what communities want and what they can afford to pay demands a certain level of water literacy and education is part of the engagement process, she says.

Other challenges include new and aging infrastructure demands. How to pay for that is an ongoing issue. While infrastructure in general is getting its "moment in the sun" in Australia in terms of private investment interest, says Cade ("all our premiers want to be infrastructure minister") – water tends to get left out of the privatising conversation.

"Water is still a pretty emotional thing and most politicians don't want to go near it in terms of getting increased private sector involvement."

As to whether water utilities should be privatised – it probably depends on the buyer. She points out that pension funds, for instance, have a long-term outlook and in places like the UK have proved benign water infrastructure owners.

Looking forward, Cade says that, despite 20 years of reform, work is still needed around clarity in water policy. One problem is that it's apt to sway in the political breeze – and a series of single-term governments and revolving door leaders is not helping.

"[Policy making] has always been done by Governments which is OK when Government is stable but hard when it's not," says Cade.

Looking ahead, she says water remains politically sensitive in terms of using private capital – though the scale in some parts of the sector is attractive.

"There is around $A140 billion of assets in the water sector and it spends $10-12 billion annually in capex. That makes a strong case for government and private sector component to keep evolving the procurement models and frameworks we use – and getting something more efficient.

"So the focus is on conceiving, delivering and operating the right water infrastructure that provides reliable high-quality water at a price the community can afford." **WNZ**

• *Lucia Cade has extensive experience in the utility, infrastructure and construction Industries in Australasia, is a past President of the Australian Water Association and current chair of Western Water. She was speaking at Water New Zealand's 2015 annual conference.*

EMERGENCY RAINWATER TANKS WATER QUALITY AND CHARACTERISTICS

Lucile Marsollier and Mathilde Bertrand ,National School for Water and Environmental Engineering and Stan Abbott, Group Leader, Roof Water Harvesting Centre, Massey University, Wellington.

This paper is a report on a study performed during an internship at the Roof Water Harvesting Centre by Lucile Marsollier and Mathilde Bertrand, fourth year students from the National School for Water and Environmental Engineering (ENGEES) in Strasbourg (France).

INTRODUCTION

The Christchurch earthquake (22 February 2011) was a powerful natural event that severely damaged our second-largest city, killing 184 people in what has been described as one of this country's worst peacetime disasters. It caused widespread damage across Christchurch, especially in the central city and eastern suburbs. The damage was exacerbated because buildings and infrastructure had already been weakened by the 4 September 2010 earthquake and its aftershocks. Of eight main water reservoirs, seven had been damaged and/or emptied during the February event, and some of the structural damage to reservoirs and pipes was severe (canterburyearthquake.govt.nz 2011; ccc.govt.nz 2011). Fonterra provided milk tankers to bring in water, the Army provided desalination plants, and bottled supplies were sent in by volunteers and companies. While more than 80 percent of the Christchurch water supply was restored within two weeks of the February earthquake, boil-water notices remained in place city-wide until April 2011. Some communities were still without mains water supply more than 100 days after the earthquake and at times people waited for up to five hours for water tankers to arrive at welfare centres (Dearnaley 2011).

Roof-collected rainwater harvesting has proven to be a sustainable alternative water supply during disasters, and can provide considerable social welfare benefits to the disaster affected communities. Small and simple, economically-feasible rainwater harvesting systems have been installed in relief camps in many earthquake-affected areas around the world.

In a recent Wellington study, it was shown that the strategic placement of large (> 25,000 liters) rainwater tanks at accessible sites (such as at schools, churches and designated distribution centers) presents several advantages to affected communities – not least that the critical lifeline of water is immediately available during an emergency response (Abbott, Moore & Golay 2011). However, after a disaster, not everyone in a community may be able to access the sites where bulk council water storage tanks are located. A Massey University pilot study demonstrated that rainwater harvesting by the homeowners themselves can be a realistic option for an emergency water supply, in terms of costs, simplicity of installation and maintenance. Installing a small rainwater tank is a straightforward process and can be done by a home handy man (or woman) within one to two hours (Abbott & Thorn 2012). This includes the time necessary for cutting the down pipe, installing the water collector/diverter and linking the rain harvesting system to the tank (Figure 1). Home owners in Wellington are now being encouraged by the Wellington Region Emergency Management Office to install relatively low priced ($105) small 200 litre rainwater tanks on their properties (Figure 2).

PURPOSE OF THE STUDY

The purpose of this study was to investigate certain aspects of rainwater harvesting for emergencies by 21 home owners in the Greater Wellington Region namely:

- The microbiological quality of the rainwater tanks over a four month period;
- The characteristics of the rainwater tanks, including tank accessories, roofing material, and likely sources of any microbial roof contamination;
- Types and regularity of preventative maintenance procedures carried out by the home owners;
- Factors that could affect the water quality of the harvested rainwater over time; and
- Home owner's knowledge of emergency water treatment methods, water usage per person per day, and the location of the council's bulk emergency water storage tanks in their region.

METHODOLOGY

Questionnaire: At the time of the first water sampling event in May 2015,

Figure 1: A 250 litre GutterWitch rain water tank connected to down pipe via debris screen and water diverter.

Figure 2: A 200 litre WREMO rain water tank connected to down pipe via water diverter.

Figure 3: Mathilde Bertrand and Lucile Marsollier after installation of new gutters, downpipes, water diverter and 200 litre rainwater tank in Brooklyn.

each resident was asked to complete a form containing 31 questions on aspects of their rainwater harvesting and about the measures they took to safeguard their emergency water supply from contamination. Prior to the June and September water sampling events, residents were asked to provide details of any preventative maintenance that was undertaken since we sent them the previous water sample's microbiological results.

Water sampling: We recorded the total rainfall (mm) for each region prior to each of the three sampling events: one day prior for the May sampling, four days prior for the June sampling, and one day prior for the September water sampling. Each resident was provided with a one-page instruction sheet on how to collect the water sample correctly from their rainwater tank. This included instructions on how to disinfect the tank tap with an alcohol

wipe and how to prevent inadvertent contamination of the sterile sample bottle during sampling. The water samples were collected aseptically in sterile 250ml plastic bottles, placed on ice packs in a chilly-bin and transported to the laboratory, usually within 12 hours.

Microbiological analyses: All water samples were processed within six hours of arrival in the laboratory. The samples were analysed for total coliforms and Escherichia coli using the Colilert / 97 Well Qaunti-tray system (IDEXX Laboratories, Westbrook, Maine, United States). Control cultures were put up at regular intervals throughout the study. A nutrient agar culture of Klebsiella pneumoniae was used as a partial positive control (yellow wells but no fluorescence) and a nutrient agar culture of Escherichia coli as a complete positive control (yellow and blue fluorescent wells). A nutrient agar culture of Pseudomonas aeruginosa was used as the negative control (no yellow wells and no fluorescent wells). After incubation, the number of total coliforms and Escherichia coli per 100 ml, based on the number of positive wells counted, was determined by referring to a 97-well MPN table (IDEXX version 3.0 MPN software programme). Wells showing no yellow colour were considered negative for total coliforms and wells showing no fluorescence were considered negative for Escherichia coli.

Reporting laboratory results: All residents were sent a laboratory report, usually within two days of the analysis of their water sample, containing the results together with our interpretation of the meaning of the results. Total coliforms were indicative of environmental contamination (eg. soil and vegetation) and Escherichia coli indicative of faecal contamination (eg. faecal droppings from birds, possums, rats etc.). We also advised the residents that that the water quality in their rainwater tank is dynamic and could change dramatically (for better or worse) after the next rainfall event. Further, we advised them that regardless of the result they should either boil the water for one to five minutes or disinfect the water with sodium hypochlorite or hydrogen peroxide based products if they want to use the water in an emergency.

RESULTS

The word limit for this publication precludes us from presenting the full details, including many tables, of all the results but readers can if they so wish contact the corresponding author Stan Abbott and request more details of data sets and copies of the questionnaire.

Fig 4: A 250 litre DEVAN rain water tank connected to down pipe via screened rain head and a 25 litre first flush diverter.

Table 1: Location and characteristics of rainwater tanks and likely roof contamination sources

TANK	LOCATION	TYPE OF TANK	CAPACITY (L)	TANK ACCESSORIES	OVERHANGING TREES OR BRANCHES ON ROOF	BIRDS ON ROOF
1	Lower Hutt	Guttertank	250	Leaf slide	few	sometimes
2	Wellington	Guttertank	600	Nil	none	sometimes
3	Karori	Wremo	200	Leaf slide	none	sometimes
4	Miramar	Guttertank	600	Nil	moderate	sometimes
5	Paraparaumu	Guttertank	250	Leaf slide	none	very often
6	Haitaitai	Guttertank	250	Nil	moderate	sometimes
7	Paekakariki	Devan	1000	Nil	few	often
8	Paekakariki	Guttertank	250	Leaf slide & FFD	few	often
9	Porirua	Guttertank	250	Nil	none	never
10	Kelburn	Guttertank	250	Nil	none	sometimes
11	Paparangi	Wremo	200	Nil	few	sometimes
12	Paekakariki	Wilson	1000	Nil	none	sometimes
13	Johnsonville	Garantia	200	Gutter screens	few	often
14	Levin	Urba	800	Leaf slide & FFD	none	sometimes
15	Te Horo	Duracrete	20,000	FFD, UV & Filtration	none	often
16	Upper Hutt	Devan	25,000	Gutter screens	none	sometimes
17	Levin	Guttertank	250	Leaf slide	none	sometimes
18	Pukerua Bay	Guttertank	250	Gutter screens	few	never
19	Brooklyn	Wremo	200	Leaf slide	none	never
20	Horokiwi	Acqau	25,000	Nil	none	sometimes
21	Mount Cook	Steel	1000	Nil	few	often

Tank locations, characteristics and roof features: The locations and types of tanks are shown in Table 1. The majority of the tanks are plastic (polyethylene) ranging from 200-25,000 litre capacity. Except for tank No15, all the tanks are situated above ground. Seven of the 21 tanks are connected to downpipes that have debris screens (leaf slides) and two tanks are connected to first flush diverters (FFD) as well. Tank No.7 has a 25 litre first flush diverter and tank No. 15 is connected to an in-ground 120 litre diverter. The water drawn from this tank is also UV treated and filtered.

Eight of the roofs are colour steel; six painted iron; four galvanised iron; one concrete tiles; one butanol; one decramastic tiles. The roofs that have overhanging trees and branches, and the frequency of birds seen on the roofs are shown in Table 1. The majority of the downpipes of the 21 homes are polyvinyl chloride (PVC) and most of the gutters are PVC also.

Water quality: The microbiological quality of the water of the 21 rainwater tanks over the three sampling events is shown in Table 2. The results show that regardless of tank location, type of roof and other features of the catchment, overall there was very little faecal contamination (eg. faecal droppings from birds, possums, rats etc.) of the rainwater over the four-month period. This is clearly demonstrated by the many <1.0 E.coli per 100 ml of tank water results. Generally, the total coliform results indicate that at some tank locations there appears to be more environmental contamination (eg. soil and vegetation) after heavy rainfall than at other tank locations. Three other noteworthy features of these results were as follows:

- The heavy environmental and faecal contamination (> 2419.6 Total coliforms and 547.5 E.coli per 100 ml) of tank No.7 (Figure 4). This was due to a blocked slow release valve in the 25 litre first flush diverter as a result of the diverter being cleaned and washed out too infrequently. Also birds were often seen on the roof.
- The heavy environmental and faecal contamination (> 2419.6 Total coliforms and >2419.6 E.coli per 100 ml) of tank No.12. However, there was a marked improvement in the water quality (15.5 Total coliforms and <1.0 E.coli per 100 ml) after the home owner completely drained the tank prior to the third sampling event.
- The heavy environmental and faecal contamination (> 2419.6 Total coliforms and 648.8 E.coli per 100 ml) of tank No.13. Besides birds often being seen on the decramastic tiled roof there was also a substantial amount of moss and lichen growing on the roof.

Preventative maintenance procedures: The preventative maintenance procedures carried out by residents to safeguard their emergency water supply from contamination is shown in Table 3. Only eight residents inspected their rainwater tanks periodically for visible contamination and 12 residents drained their tanks completely at the intervals shown in the table. Only three residents cleaned out their tanks but no resident ever

Table 2: Total coliforms and E.coli results

TANK	DATE	COLIFORMS	E.COLI	DATE	COLIFORMS	E.COLI	DATE	COLIFORMS	E.COLI
		(Per 100 ml)	(Per 100 ml)		(Per 100 ml)	(Per 100 ml)		(Per 100 ml)	(Per 100 ml)
1	25 May	2.0	<1.0	24 Jun	<1.0	<1.0	21 Sep	0.0	<1.0
2	25 May	51.2	<1.0	7 Jul	1.0	0.0	21 Sep	2.0	<1.0
3	24 May	6.3	2.00	25 Jun	2.0	1.0	23 Sep	179.3	<1.0
4	25 May	<1.0	<1.0	30 Jun	10.7	<1.0	21 Sep	248.9	9.5
5	22 May	14.8	<1.0	20 Jun	5.1	<1.0	21 Sep	0.0	<1.0
6	20 May	165.8	<1.0	1 Jul	0.0	<1.0	21 Sep	1.0	<1.0
7	20 May	>2419.6	547.50	21 Jun	6.3	1.0	23 Sep	152.9	95.0
8	20 May	209.8	5.20	21 Jun	30.9	<1.0	23 Sep	65.0	<1.0
9	21 May	<1.0	<1.0	22 Jun	2.0	<1.0	22 Sep	0.0	<1.0
10	23 May	2419.6	<1.0	21 Jun	1986.3	<1.0	21 Sep	980.4	<1.0
11	24 May	203.5	1.00	21 Jun	172.3	<1.0	23 Sep	8.5	<1.0
12	21 May	165.0	<1.0	21 Jun	>2419.6	>2419.6	24 Sep	15.5	<1.0
13	20 May	>2419.6	648.80	21 Jun	>2419.6	2.0	24 Sep	>2419.6	<1.0
14	20 May	1203.3	1.00	24 Jun	45.7	1.0	22 Sep	114.5	<1.0
15	21 May	<1.0	<1.0	17 Jun	<1.0	<1.0	23 Sep	0.0	<1.0
16	27 May	275.5	43.70	2 Jul	344.8	14.8	22 Sep	137.6	2.0
17	20 May	113.7	<1.0	24 Jun	25.6	1.0	22 Sep	88.4	<1.0
18	24 May	<1.0	<1.0	21 Jun	2.0	<1.0	22 Sep	0.0	<1.0
19	24 May	<1.0	<1.0	21 Jun	204.6	<1.0	22 Sep	10.4	<1.0
20	26 May	<1.0	<1.0	29 Jun	<1.0	<1.0	21 Sep	0.0	<1.0
21	26 May	325.5	<1.0	25 Jun	461.1	0.0	22 Sep	16.1	<1.0

disinfected their tank water. Fourteen residents regularly cleaned their gutters.

Emergency water usage and treatment: Only one resident did not know how much water they would need per person per day in an emergency. Six residents stated three litres, 10 stated 10 litres and four residents stated 20 litres. All of the 21 residents knew how to treat their rainwater in an emergency by boiling and / or disinfection with sodium hypochlorite or hydrogen peroxide-based products. All except one of the 21 residents have an additional supply of emergency water - mostly stored in one or more 20 litre plastic containers. Only seven residents knew where the council's bulk emergency storage tanks were located in their neighbourhood.

DISCUSSION

Rainfall frequency in a particular region, tank sizes and water demand will obviously influence the total amount of rainfall available for use. In some instances, there will be overflow from the tanks during a rainfall event and in other cases the tank will be empty through lack of rainfall or overuse. Obviously the ideal situation for rainwater harvesting – especially in emergencies – is consistent rainfall for dependable water usage, preferably higher usage only during times of higher rainfall. The Wellington Emergency Preparedness guide (CDEM 2010) suggests three litres of water per person per day is required to meet drinking needs, and more for cooking, hygiene and pet care. However, World Health Organisation studies say 40-50 litres per person per day is the minimum recommendation and that having less than 20 litres per person per day presents a significant health risk (Howard & Bartram 2003).

During February and March 2013, the Wellington region had no significant rainfall for 34 days. Assuming that a prolonged dry period coincides with a major earthquake in Wellington, the number of days' water supply that could be available (from various rainwater tank sizes) for different household sizes – for usage rates of 20 and 50 litres per person per day – was calculated by Beban et. al. (2013). The tables in this GNS report clearly demonstrate the value of having larger rainwater tanks for emergency water storage.

However, in a more recent GNS report, Cousins (2015) demonstrated using whole-city modelling involving a Wellington earthquake showed that acceptable security of emergency water supply for most of the people, most of the time, could be achieved with rainwater storage of either 200 litres per person, or 1000 litres per building. Cousins states that in this case the emergency water was a combination of reservoir water, household personal water and the dedicated rainwater tank supply.

Since the majority of residents in this study stated that 10 litres per day is necessary in emergencies, we show in Table 4 the number of days a full rainwater tank of various sizes would provide 10 litres of water per person per day in a period without rain for different household sizes. Having a larger rainwater tank means that in emergencies more

Table 3: Occurrence of preventative maintenance procedures

TANK	TANK INSPECTED	TANK DRAINED	TANK CLEANED	TANK	GUTTER CLEANED
1	never	yearly	never	never	yearly
2	yearly	6 monthly	never	never	6 monthly
3	never	never	never	never	never
4	3 monthly	never	never	never	yearly
5	never	yearly	never	never	yearly
6	never	3 monthly	never	never	yearly
7	never	never	never	never	18 monthly
8	never	never	never	never	yearly
9	never	never	never	never	6 monthly
10	6 monthly	yearly	never	NIF	never
11	yearly	yearly	yes	never	yearly
12	never	6 monthly	never	never	never
13	never	periodically	never	NIF	never
14	3 monthly	never	never	never	never
15	3 monthly	never	never	never	yearly
16	never	never	never	never	6 monthly
17	6 monthly	yearly	yes	never	2 yearly
18	3 monthly	yearly	never	NIF	never
19	6 monthly	yearly	yes	never	never
20	periodically	dnt know	never	never	6 monthly
21	never	6 monthly	never	never	6 monthly

Table 4: Number of days a full rainwater tank would provide 10 litres of water per person per day in a period without rain.

TANK SIZE	Number of days that a full rainwater tank would provide 10 litres per person per day in a period with no rainfall		
	HOUSEHOLD OCCUPANTS		
	2	3	4
200 L	10.0 days	6.7 days	5.0 days
500 L	25.0 days	16.7 days	12.5 days
600 L	30.0 days	20.0 days	15.0 days
1000 L	50.0 days	33.3 days	25.0 days
2000 L	100.0 days	66.7 days	50.0 days
5000 L	250.0 days	166.7 days	125.0 days

water will be available not only for drinking, oral hygiene, utensil washing, food preparation and washing but also for pet care and even toilet flushing. The toilet could be flushed by pouring the rainwater from 10 litre buckets into the toilet cistern.

We believe therefore that home owners should install larger rainwater tanks if they have the space on their properties and if they can afford them.

Currently there is a wide range of tanks types and sizes available in New Zealand. For example in Wellington, collapsible PVC rainwater barrels (with water diverter) are retailing for $99.95 (200 litres) and $129.95 (400 litres). **WNZ**

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Fig 5: Rewi Elliot, Manager of Otari-Wilton Bush in Wellington with six 250 litre rainwater tanks he installed in the reserve.

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Re-engineering urban streams

The Effects of Daylighting on Stream Ecology

This is an edited version of the Hynds Paper of the Year Gold Award winner as presented at the Water New Zealand conference. A full version can be found at www.water.org.nz

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ABSTRACT

The culverting of streams is widespread in cities and has been described as the most severe form of stream modification, because most interactions between the stream and the surrounding environment are lost. Daylighting, which involves recreating an open stream from a buried channel, has been promoted by some agencies (e.g. US EPA, CIWEM). Whilst daylighting can theoretically restore stream systems and natural processes, a review of projects across the world found that there were no empirical assessments of the effectiveness of daylighting projects.

The daylighting of two stream reaches in Auckland in 2013 provided an opportunity to address this knowledge gap and assess the effects of daylighting on stream ecology. Stream macroinvertebrates were sampled monthly pre- and post-daylighting and showed significant changes in community structure associated with improved habitat and increased food resources following daylighting. Whilst there were changes in the species living in the streams after daylighting, little change was observed in commonly used measures of stream health (i.e. species richness, MCI) post-daylighting. The response of the invertebrate community was different in the two reaches, with the reach that had more intact headwaters showing a greater change in ecology (71 percent) compared with the reach with extensively piped headwaters (58 percent).

KEYWORDS

Daylighting, deculverting, macroinvertebrates, urban streams, restoration

1 INTRODUCTION

The extent of urban areas across the globe is increasing as human populations become concentrated in cities, with widespread environmental consequences across the earth's air, land and water resources (Paul & Meyer, 2001; Foley et al, 2005). The effects of urbanisation have been well described for streams, with numerous studies describing a degradation of morphological, chemical and biological stream condition associated with increasing urbanisation; a phenomenon that has subsequently been described as an Urban Stream Syndrome (Meyer et al., 2005; Walsh et al., 2005).

Recognition of the effects of urbanisation on streams has led to a change in the management and development of urban catchments through time, with progression from centralised systems that use piped drainage, to increasingly decentralised management using natural drainage features (Hale et al., 2015). These changes have been successful in reducing the impacts of urbanisation at the time of new development. However, there are numerous legacy issues arising from historical management approaches and there are few examples of significant recovery of urban streams arising from efforts to remedy these issues. This is largely because project outcomes are not monitored (Bernhardt et al., 2007), or where monitoring is carried out, it shows no significant difference between restored and non-restored streams (e.g. Violin et al., 2011).

One such legacy issue is the extent of culverted streams; culverting is widespread in many cities (Broadhead et al., 2013) and has been carried out largely to increase building platforms or manage flooding issues. Culverting has been described as the most severe form of stream modification because most interactions between the stream and the surrounding environment are removed (Elmore & Kaushal, 2008).

The concept of stream daylighting (also known as deculverting) has recently gained favour amongst some agencies (e.g. Scottish Environmental Protection Agency, Chartered Institution of Water and Environmental Management and Zurich City Council) as a tool for restoring culverted streams. Conceptually, stream daylighting is a radical form of stream restoration; effectively re-creating a stream from a buried or piped channel. As such, it had been suggested that daylighting can restore natural processes, stream function and biodiversity (Pinkham, 2000). However, there are no studies reporting the effects of daylighting urban streams, rather success is assumed or reported anecdotally (Wild et al., 2011; Broadhead et al., 2013). Given efforts to promote stream daylighting as a restoration tool, it is important that the effects of d aylighting are understood.

In this paper we report on a study of the changes in the invertebrate community in two streams that were daylighted in 2013. Invertebrates are commonly used as indicators of stream health because:

- They are ubiquitous and abundant in rivers;
- Sampling procedures are well developed, easy to apply and inexpensive;
- Comprehensive keys are available for identification;
- Macroinvertebrate communities are heterogeneous (species rich) offering a spectrum of responses to environmental conditions; and
- Macroinvertebrates are sedentary and therefore representative of the location where they are found.

As a result of the combination of the above characteristics, macroinvertebrates act as continuous indicators of the health of the river they inhabit and consequently they are established as the indicator of choice in most biological river monitoring programmes (Rosenberg & Resh, 1993). Importantly, invertebrate communities have been correlated with a wide range of chemical, biological and functional measures of river health and therefore can reliably be used as an indicator for these other measures.

We predicted that daylighting would lead to significant changes in the invertebrate communities in the two streams and our objective was to assess the short term (two years) stream invertebrate community response to daylighting.

2 METHODS

2.1. STUDY SITES

Two stream reaches in the La Rosa Reserve, Auckland were daylighted in April and May 2013. The reaches were located on the Waitahurangi (North) and Parahiku (South) Streams, both of which are in the predominantly urbanized Avondale Stream catchment (Figure 1).

The daylighting in each stream reach consisted of the removal of 180 metres of concrete piped channel (1500mm diameter), which was replaced by soft-engineered stream channels and banks (Figure 2). Newly created stream banks and riparian areas were planted with native species.

Whilst both streams are heavily urbanized, the contributing upstream catchments of the two stream reaches differed in character (Table 1). The Parahiku Stream had a larger catchment (126 hectares), with a greater extent of un-piped channel (45 percent) compared with the Waitahurangi Stream (63 hectares and 17 percent un-piped). The Parahiku Stream had a lesser extent of urban cover (79 percent) when compared with the Waitahurangi Stream (94 percent), and the Parahiku Stream had a large area of native Podocarp forest in its headwaters.

2.2. INVERTEBRATE SAMPLING METHODS

Prior to daylighting, invertebrate samples were collected from the culverts to be removed in the two streams. Two samples were collected from the Waitahurangi Stream in March and April 2013 (daylighted in late April 2013) and one sample from the Parahiku stream in May 2013 (daylighted in late May 2013).

Daylighted reaches were then sampled monthly through to June 2015, representing 25 samples from the Waitahurangi Stream and 23 from the Parahiku Stream post-daylighting.

As there is no standard method for sampling invertebrates in culverts, we used a modified version of the standard national protocol for streams (Protocol C1; Stark et al., 2001). Prior to daylighting, invertebrates were sampled by inserting a net into the culvert and disturbing the accessible substrate.

Subsequent to daylighting, invertebrate samples were collected using the standard protocol for hard bottom streams (Protocol C1; Stark et al., 2001). Briefly, a fixed area (0.2 m2) of stream bed was disturbed upstream of a kick-net at five locations within each of the daylighted reaches. These five sampling units were pooled to give one sample per reach per month. Samples were preserved in ethanol and sorted and identified following standard protocols (Stark & Maxted, 2007).

Figure 1: Map showing the location of the daylighted stream reaches. Sampling locations are shown by white circles. The opaque polygon shows the location of the La Rosa reserve and the sampling locations within this polygon represent the daylighted reaches. In the wider catchment, open channels (un-piped) are indicated by white lines and piped channel is shown as black lines.

Figure 2: Time series photographs showing the change in channel appearance of the Waitahurangi Stream pre- and post-daylighting.

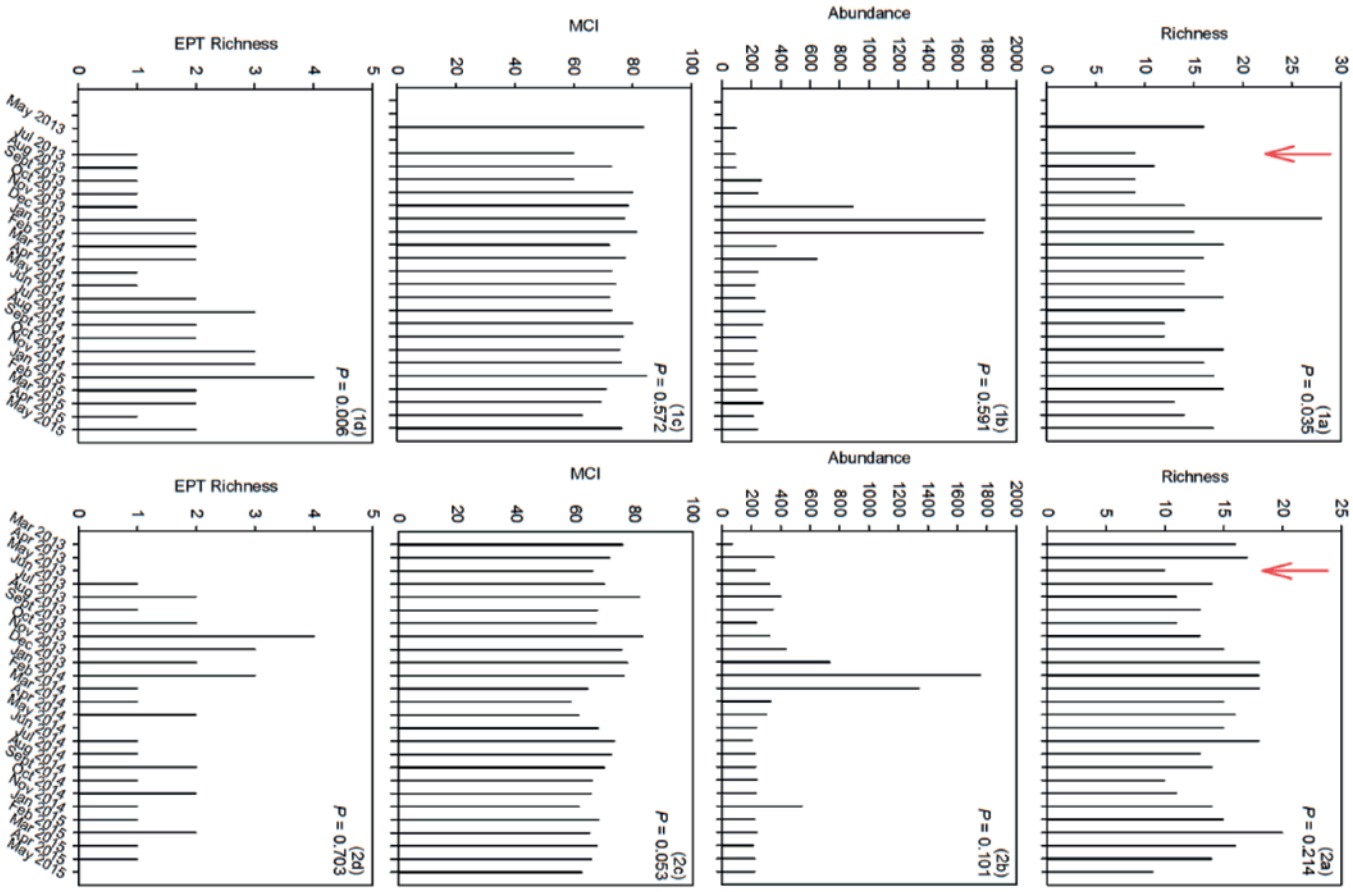

Figure 3: Stream ecological health pre- and post- daylighting as described by four indices in 1) Waitahurangi Stream and 2) Parahiku Stream. Where dates are not shown on the x-axis no samples were collected. The red arrow indicates the first post-daylighting sample.

2.3 DATA ANALYSIS

The taxonomic information that is generated from invertebrate samples is commonly summarised into indices. The use of indices aids communication of the taxonomic information and allows rapid comparisons among numerous sites and samples. In this paper, the invertebrate data were summarized using four indices that are commonly used in New Zealand; taxon richness, total abundance, Macroinvertebrate Community Index (MCI) and EPT (Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies)) richness. Change over time in these indices was analysed using the Mann Kendall trend test.

Changes in invertebrate community pre- and post-daylighting were assessed using Similarity Percentages (SIMPER) in the PRIMER package. SIMPER gives an indication of the relative change in invertebrate community arising from the daylighting activity.

3 RESULTS

A total of 69 invertebrate taxa were recorded from the 51 samples that were collected from the two daylighted stream reaches. Twenty-four taxa were recorded both before and after daylighting, whereas 46 taxa were collected only after daylighting. These 46 new taxa included nine taxa belonging to the sensitive EPT groups, including two Ephemeroptera (the mayflies Neozephlebia and Zephlebia), one Plecoptera (the stonefly Acroperla), and six Trichoptera (the caddisflies Orthopsyche, Oxyethira, Paraoxyethira, Plectrocnemia, Polyplectropus and Psilochorema).

Significant changes in invertebrate community were observed in both streams. However, SIMPER analysis of the change in invertebrate community composition indicated a greater change in the Parahiku Stream (71 percent dissimilarity) than in the Waitahurangi Stream (58 percent). In both streams, the taxa which contributed the most to the dissimilarity between pre- and post-daylighted invertebrate communities were Potamopyrgus (the New Zealand mudsnail), Acroperla (stonefly), Oligochaeta (worms), Polypedilum and Orthocladiinae (both midges).

Only two of the eight possible trends tests (four metrics at two sites) returned a statistically significant result (Figure 3), both of which were in the Waitahurangi Stream. EPT richness increased post-daylighting in both reaches, however this difference was only significant in the Parahiku Stream (Sen Slope 0.789, P = 0.006). The only other significant trend was for taxa richness at Parahiku Stream (Sen Slope 2.554, P = 0.035).

4 DISCUSSION

Stream daylighting is at the extreme end of the continuum of stream restoration options, representing a dramatic

and almost immediate change in the appearance and morphology of a stream. Daylighting has been widely advocated as a management option for urban streams for over 10 years (Pinkham, 2000), yet this is the first study to empirically assess the effects of daylighting on stream ecology.

Invertebrate community structure changed significantly as a result of daylighting in both of the streams, including the appearance of 46 taxa not found prior to daylighting. The changes in community composition were more pronounced in the Parahiku Stream. We hypothesise that the presence of forested headwaters above the daylighted reach in the Parahiku Stream was the primary driver of this greater change. Auckland Council State of the Environment data indicates a relatively healthy invertebrate community in these forested headwaters, which likely provided a source of colonists for the newly daylighted stream.

We recorded 46 taxa post-daylighting that were not recorded in the pre-daylighting samples. We posit that this large increase in diversity following the daylighting of the streams is an indication of an improvement in the ecological health of these streams. Similarly, we consider that the increases in sensitive EPT taxa observed at both sites represent an improvement in stream health.

The absence of significantly improving trends in the commonly used metrics of stream health (particularly MCI) is somewhat disappointing. However, change in these metrics following restoration may occur over longer timescales than the data presented here. Alternatively, the improvement in local habitat arising from daylighting may be overwhelmed by catchment scale impacts (Miller et al., 2010). This is a distinct possibility in these streams as the catchments are primarily urban and extensive lengths of piped channel remain upstream in both catchments.

5 CONCLUSIONS

Whilst daylighting had a significant effect on invertebrate community composition, particularly the positive increases in the presence of sensitive EPT taxa, there were not concordant improvements in stream health metrics commonly used in New Zealand (e.g. MCI).

Daylighting streams may provide some local improvements in habitat that are associated with changes in invertebrate communities, but significant recovery of urban streams is likely to require the management of catchment scale factors in addition to localized restoration activities such as daylighting. To maximize the potential ecological improvements arising from daylighting streams, it is important to consider the source of colonists that may colonise any improved stream habitat. **WNZ**

ACKNOWLEDGEMENTS

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MANAGED AQUIFER RECHARGE IN POVERTY BAY

Golder Associates senior hydrogeologist Clare Houlbrooke with Robert Bower and Brett Sinclair.
This is the abstract of the Hynds Paper of the Year Silver Award winner as presented at the Water New Zealand conference. A full version can be found at www.water.org.nz

ABSTRACT

The Gisborne District Council (GDC) has identified long term water availability in the Poverty Bay area as being a potentially limiting factor in future regional development. A substantial proportion of the water used for irrigation across the Poverty Bay Flats is derived from groundwater, with most of the abstraction being from the confined Makauri Aquifer.

Reviews of groundwater levels in the Poverty Bay Flats area have identified declining groundwater pressure trends in this aquifer as an environmental and water supply reliability issue. These trends are linked to increasing groundwater abstraction for irrigation purposes. Current groundwater abstraction rates are, however, substantially less than the consented allocations.

The GDC is investigating water management options to stabilize and restore groundwater trends and improve future water supply reliability in the Poverty Bay area. One option under investigation is the use of Managed Aquifer Recharge (MAR) to replenish and sustain groundwater yields from aquifers beneath the Poverty Bay Flats.

Golder Associates (NZ) Limited (Golder) was commissioned by GDC to undertake a pre-feasibility assessment for a MAR program.

The MAR pre-feasibility assessment carried out by Golder included an evaluation of the challenges and needs for Poverty Bay water management, source water options, direct injection and surface inf iltration options and water quality management requirements. The pre-feasibility analysis indicated a groundwater replenishment scheme (GRS) focused on the Makauri Aquifer has the potential to:

- Stabilise and restore downward trends in groundwater levels within the aquifer;
- Restore groundwater pressures within the aquifer; and
- Enable the establishment of a sustainable yard from the aquifer that exceeds current usage.

A full feasibility study has now been initiated by GDC, including construction of a pilot injection bore to be drilled into the Makauri Aquifer and an injection trial to be undertaken during 2015-2016.

Pumping and flow control equipment together with monitoring systems are to be installed in the injection bore. Monitoring systems will also be installed in selected nearby bores to track aquifer pressure and water storage responses to the trial. Changes in groundwater quality in response to the injection program will also be monitored.

In summary, Managed Aquifer Recharge (MAR) has the potential to replenish and support sustainable groundwater yields from aquifers beneath the Poverty Bay Flats. The next step in establishing a GRS for Poverty Bay is the construction and testing of a pilot trial injection bore. www.water.org.nz **WNZ**

This Pilot Project is being carried out by Golder Associates (NZ) Limited on behalf of Gisborne District Council. The project has had guidance and input from the Freshwater Advisory Group (FwAG). Members of the FwAG, GDC and supporting organisations highly involved in the Pilot Project include Dennis Crone and Paul Murphy (GDC), Peter Williamson, Stuart Davis, Allan Horanga and Trevor Lupton. The Pilot Project has received sponsorship from Eastland Community Trust and Ministry for Primary Industry. We wish to acknowledge and thank the supporting organisations and members of the Pilot Project team.

BORING INJECTION INOCULATES AGAINST EXPENSIVE UPGRADES

Rob Darby, project manager with the Queenstown Lakes District Council, earned the Hynds Paper of the Year Bronze award for this paper. The award was presented at the recent Water New Zealand conference. A full version can be found at www.water.org.nz

ABSTRACT

Queenstown Lakes District Council's (QLDC) water supply systems include 17 reservoirs with associated rising and falling mains. Although this technology is well established and robust, it is an expensive way to address the needs of an ever-growing community and associated peak water demand.

Water modelling has been used to demonstrate the effectiveness of direct injection as a means to address peak water demand.

Over the past four years, QLDC has undertaken 30 to 40 exploratory bores and constructed eight production bores. This was in order to either improve existing bore fields, or to provide an entirely new water source.

The overriding principle has been to optimise or re-utilise existing assets rather than expenditure on new and relatively expensive capital upgrades. Wherever possible, the opportunity to improve redundancy and resilience has been pursued.

This paper will describe the voyage of discovery – the highs (the excitement of drill rig operators) and the lows (silt, silt and eggy smelling water). It will describe modelling outcomes and present the various solutions now being considered for a number of unique situations in the QLDC area. www.water.org.nz **WNZ**

Hitting the hard end of drinking water law

Eight years down the track, 2007 drinking water legislation has finally got to the pointy end of compliance – and small suppliers are struggling, as Opus principal environmental scientist **Jim Graham** explains.

It seems that we have finally got to the pointy end of complying with the 2007 drinking-water legislation. The part that some Councils warned about, back when the legislation was being passed. The costs per person to upgrade supplies which provide water to communities of 500 people or less are very high. And many communities are not keen to pay.

There wasn't too much of a problem in July 2012 when large supplies serving more than 10,000 people were required to take all practicable steps to comply with the drinking-water standards. Most of them already did and Water Safety Plans (PHRMP's at the time) were being written.

By July 2013, medium supplies serving 5001 to 10,000 people were required to comply. Again many of them already did comply and Councils were generally comfortable with the need to upgrade those supplies that didn't. Rating bases in these communities were such that the costs could generally be spread wide enough to make the upgrades manageable.

The minor supplies, serving 501 to 5000 people had a July 2014 compliance date and many supplies received subsidies from the Ministry of Health, significantly reducing the costs to rate payers. Not all though and many more communities that would

struggle to fund upgrading costs were not eligible for subsidies. That was even more the case after 2008 when the incoming Government tightened the subsidised criteria, reduced the amount of subsidy funding available and made the scheme less accessible.

But the July 2015 compliance date for small supplies serving 101 to 500 people has now passed and many supplies in this category don't comply with the standards. And many won't anytime soon.

The last Ministry of Health Annual Survey, covering the period July 2013 to June 2014 tells the story. Ninety percent of large supplies comply with the standards – 99 percent for bacteriological compliance and 90 percent for protozoa compliance. Ninety eight percent of medium supplies meet the bacteriological requirements and 57 percent meet the protozoa requirements. Minor supplies show similar results; 89 percent for bacteriological and 48 percent for protozoa.

The bacteriological compliance figures are good. The protozoa figures not so good. But what is the real problem here?

In many situations, it is not that protozoa barriers are not in place, it's demonstrating protozoa compliance that is difficult. For example, many of these supplies have UV systems installed but Councils are having difficulty collecting, managing and presenting the necessary continuous compliance data to demonstrate compliance. But that's another story.

The other two percent

The situation for small supplies, I believe, is different. While 72 percent met bacteriological compliance, only 24 percent met protozoa compliance and 21 percent overall compliance.

From what I see around the country, many supplies in this category don't have protozoa barriers installed. They are often chlorine only supplies. This is 79,700 people, only two percent of the population.

The problem for these communities is the cost of installing those protozoa barriers. Especially now that the subsidy programme has finished. Here's an example. To comply with the standards, a small supply serving 220 people and using a surface water source needs an upgrade including pressure sand filters, cartridge filters, UV, a new pump, turbidity meter, PLC, chlorine dosing, monitoring equipment, telemetry, pipework, storage, electrical, a new building etc. Total cost – around $400,000. That is a cost per head of about $1800. For low income people in a community with a deprivation index of 10, that is not a cost they will usually agree to pay.

So some Councils with communities like this are considering not demonstrating compliance with the standards, arguing that it is not affordable for the communities concerned. They may upgrade the supplies to some extent, but not to demonstrate standards compliance.

How does this approach fit with the legislation?

The Health (Drinking Water) Amendment Act 2007 requires water suppliers to take all practicable steps to comply with the standards. This was a contentious issue when the Bill was discussed in the select committee.

It was agreed at that time that all practicable steps should take account of the affordability of complying with the standards. The onus is on the water supplier to demonstrate that compliance is not affordable. But it was also agreed that preparing a water safety plan for the supply, demonstrated that all practicable steps were being taken, even if the supply did not comply with the standards.

These provisions in the Act create some ambiguity and make compliance and enforcement of the Act less than clear.

So some Councils are preparing water safety plans for small supplies which manage risks and will lead to the provision of potable water – but not standards compliance. They argue that they are taking all practicable steps and are complying with the legislation, if not the standards themselves.

The catch to this is that some Drinking Water Assessors, who are tasked with assessing compliance with the standards and Act, are not approving the plans unless they show a path to standards compliance. My view is that such a position is not correct.

The Act says that water safety plans (phrmps) must identify public health risks, critical points and mechanisms for preventing, reducing and eliminating those risks – nothing about complying with the standards. That's a different part of the Act.

Drinking Water Assessors can only assess a water safety plan against what is actually required by the Act. Nothing more, nothing less.

How this plays out over the next few years will be interesting. Small supplies, of which there are some 300 registered, might test the legislation. If upgrading is not affordable and a water safety plan is sufficient to ensure risks are managed, safe water is provided and the Act is complied with, where does standards compliance fit for those supplies?

When affordability becomes an issue, the Act is not entirely clear. I for one will watch this space with interest. **WNZ**

• *Jim Graham is a principal environmental scientist with Opus and provides advice and services to water suppliers, particularly in the area of water treatment options, managing risk, drinking-water standards and legislative compliance. Jim also teaches on the NZ Weta drinking-water certificate, diploma and other courses. Before joining Opus, Jim worked for the Ministry of Health and was involved with preparation of the Health (Drinking Water) Amendment Act, Drinking Water Standards and the Drinking Water Subsidy Programme.*

A gift of clean water saves lives

In the Papua New Guinea Highlands, mothers about to give birth are often forced to lug their own water to birthing centres that lack a clean water supply. Oxfam is working to improve their lot and your company can help.

Papua New Guinea (PNG) ranks among the bottom 10 countries globally for a lack of clean, safe water and sanitation. Despite having one of the highest rainfalls in the world, less than 10 per cent of people living in the Highlands (2.8 million people) have access to safe water and even fewer have access to sanitation. Waterways are often polluted with sewage or residue from coffee processing or mining in the area.

Much of PNG's population lives in small, remote communities where government services are few and far between. This affects people's health, with local community health centres often being forced to shut down because of a lack of clean water.

Oxfam is working with local partners to change this. Clean water is essential and transforms the lives of communities who are forced to drink and use dirty water daily.

Oxfam is working in health centres across the Highlands of PNG to make a difference for local communities, especially women. When an expectant mother goes into labour, she needs water and clean surroundings to ensure her and baby stay healthy during and after childbirth.

Yet, right now, in PNG, some rural health centres lack even the most basic water and hygiene facilities. Unbelievably, many women, while they are in the agonies of childbirth, are forced to haul 200 litres of water from a nearby creek to the health centre and they have to undertake this gruelling journey several times before there is enough water at the health centre. A lack of sanitation means that often babies are born with lifelong health problems.

Alda Wangs, 25, from Apante in the Eastern Highlands, recently told us what happened when she arrived at the nearby Henganofi Health Centre, already in the throes of labour:

"They said that they had no water so the health centre is closed. No health worker was present at the time so I came back to the village to deliver…This was my first time and I really had a hard time delivering my baby. I lost a lot of blood and fainted so they took me to the hospital in the morning."

It's not hard to see how this lack of water is endangering the lives of women like Alda.

Jonas Tevesabo is a Health Office at Henganofi Health Centre where Alda went. He's seen more than most just what a problem a lack of water is.

"Water is a big need for the health centre. Currently there is no water at the labour ward, so the labour mother or relative has to fill up a 200 litre drum from a nearby creek before she can give birth. If the labour mother is on her own, she must collect the water herself so the baby can be delivered at the centre."

This has terrible repercussions. Dirty equipment is often used during delivery. Women can easily become infected after childbirth if there is no water to wash with. In places like Henganofi, the lack of access to clean, running water and adequate sanitation is a life-threatening problem. And sadly it's not just the mothers who are suffering.

Lack of clean water and sanitation means diseases such as typhoid and dysentery are commona and it's always the youngest children who are most vulnerable.

Alda's daughter, Maxlin, is now six months old and frequently suffers from diarrhoea and fever, probably because she was born without adequate facilities.

Oxfam is working to change this. We have WASH projects in 26 health centres across the Highlands, installing simple, sustainable solutions like rainwater tanks, toilets and tap stands, ensuring local communities have clean water all year round. Through our local partners, we are installing water taps into labour wards to ensure that mothers can deliver their babies in a clean and safe environment.

How you can make a difference

Oxfam's annual event, the Oxfam Water Challenge, is back, and better than ever before. This year all funds raised will be used to help women like Alda.

To ensure that six health centres have clean water, each with two functioning and sanitary toilets, and locals are training through health and hygiene workshops, Oxfam needs to raise $50,000. You can help by entering the Oxfam Water Challenge.

Building on last year's fantastic event, the Oxfam Water Challenge will see 25 teams of four get together and raise a minimum of $2000 – this will help us reach a collective target of $50,000.

But it's not all about fundraising.

As your donations increase, your team will be given incentives and clues that will culminate in a challenge day in Auckland on 20 February 2016. We will be bringing all

Less than 10% of PNG Highlanders have access to clean water.

teams together to design, build and operate a solution to their brand new water-based challenge.

This is your chance to prove you're the best in the business while having loads of fun – and win a chance to see some of Oxfam's projects in the Pacific while you're at it!

As you'll see, the 2014/15 winners, MWH Auckland Avengers, got a lot out of their involvement last year – as Sarah Davies from MWH Global summed it up:

"When MWH entered two teams in the Oxfam Water Challenge last year, we thought it was just a way to raise money for a good cause but we got so much more. We learned skills in fundraising, publicity, team work, innovation and project management — plus a greater understanding of the challenges of working in developing countries."

The Challenge

Is your company good enough to steal the trophy from last year's winners? Why not put your skills and experience to the test, build a great bond with your colleagues and take on the challenge to make a difference for vulnerable communities in PNG.

If you have any questions or would like to find out more, do not hesitate to get in touch or check out Oxfam's website: www.oxfam.org.nz/owc or call Hannah Davies on 09 355 6854. **WNZ**

The challenge: constructing a system capable of containing and delivering 100 litres of water to a container 5m away.

WHAT IS OXFAM DOING?

Oxfam helps to improve the health of rural communities by designing and constructing appropriate water supply systems, educating communities on the dangers of open defecation and poor hygiene practice, and encouraging households to use latrines and put new health knowledge into practice.

ACCESS TO CLEAN WATER

Oxfam works in partnership with local communities to install a range of water supply services. This includes rainwater harvesting; wells and boreholes; and gravity fed systems, which allow water to flow through pipes from natural sources all year round. These are simple yet effective solutions which are sustainable.

SANITATION WORK TO REDUCE THE SPREAD OF DISEASE

Oxfam works with communities to build latrines in carefully selected locations around villages, well away from areas where food is prepared and children play. Latrine doors ensure privacy and dignity and their location keeps vulnerable women safe. Oxfam uses a Ventilation Improved Pit (VIP) latrine design which is built with piping that minimises smells and prevents insects.

HYGIENE PROMOTION AND EDUCATION

Oxfam trains local village health volunteers to teach the essentials in hygiene, such as hand washing and safe water storage. Oxfam's hygiene experts provide communities with guidance on how to clean, manage and maintain new latrines and water infrastructure. These volunteers champion good sanitation practices for the long term, ensuring improved health throughout the community.

By always including these components, Oxfam's integrated Water, Sanitation and Hygiene Education (WASH) programmes will achieve better outcomes for the vulnerable communities.

Sustainable water development in the Pacific

Lesley Smith gets a first-hand look at water infrastructure challenges in PNG.

In September, I was fortunate to represent Water New Zealand at the eighth annual PWWA conference, held in Port Moresby and themed around "Sustainable Water Development in the Pacific". The PWWA and Water New Zealand partner on initiatives outlined in a Memorandum of Understanding and also share a number of our members. Of the 42 companies who are Allied PWWA members, 25 come from New Zealand.

PWWA conferences and membership provide a great way for New Zealand companies to identify where their goods and services might contribute to the Pacific water and wastewater sector.

Certainly there is no shortage of challenges.

The conference explored key challenges and solutions through talks and workshops themed around:

Water and technology – focusing on the need for the development of appropriate infrastructure, standards and engineering guidelines for the Pacific;

Asset Management – concentrating on increasing awareness of the value of asset management and the need for asset management training;

Measuring Sustainability – which covered topics as diverse as governance, tariffs, construction management and supervision;

Non-Revenue Water – highlighting the need for organisational commitment and dedicated staffing resources within utilities

Water and Community – addressing community-level training, land ownership issues, and the need for utilities to serve rapidly growing peri-urban communities; and

Water and Gender – this focused on promoting gender equality within the water sector and raising the profile of gender issues in water and wastewater delivery.

The conference also launched an inaugural Ministerial Forum attended by government ministers representing 20 Pacific Island countries.

Ministers committed to a seven-point agenda designed to strengthen the role of PWWA and enhance regional water outcomes. This included championing an application for the PWWA to obtain representation at the Pacific Island Forum through gaining status as a Council of Regional Organisations, a move which would dramatically enhance the political importance of the PWWA and raise the profile of water and sanitation issues in the Pacific.

The Pacific Water and Wastewater Association (PWWA) is a regional association representing 26 utilities operating water and wastewater schemes in 21 of the pacific Island countries. Started in 1994 as a loosely knit association the PWWA has evolved to become the Pacific's leading professional water body. Their vision of "shaping a cohesive, proficient and robust Pacific water sector" is underpinned by strategic goals related to skills development, representation, collaboration and upholding of standards.

1. A small child takes a wash at the inlet to the water supply to the city of Goroka.
2. Water supply and hydro-electric supply lines feeding into the capital Port Moresby. A strong El Nino has meant lowering levels for the towns hydro-electric power supply causing rolling black outs across the city.
3. Asaro Mud-men welcome Oxfam Water and Sanitation engineers, Raijeli Nicole, Regional Director for Oxfam in the Pacific, and PNG Country Director Emie Sinapa to the Sirumgolaro village. Oxfam has assisted the villagers with the installation of rainwater tanks.
4. Flowers from Lanonono. When not studying or flower arranging he helps his brother operate the town's chlorine dosing plant.

To ensure the PWWA has the capacity to deliver on its expanding role and continue to provide services to its members, the PWWA is undergoing an extensive review.

Overseen by a committee of experienced industry professionals, with financial support from the Asian Development Bank, the review aims to ensure that the PWWA has in place a sustainable governance structure, constitution and revenue stream.

The 2015 conference was hosted by EDA Ranu, and Water PNG, utilities tasked with delivering water and wastewater services to Port Moresby and remaining provincial and district towns respectively. The challenges faced by these utilities are immense.

In serviced areas, it is estimated that 89 percent of the population has access to safe water and 57 percent access to safe sanitation (down from 89 percent in 1990). However, the situation is more dire in the rural and peri-urban areas of PNG. Over 87 percent of the population lives in these areas where it is estimated only 33 percent have access to safe water while just 13 percent have access to improved sanitation (Papua New Guinea Department of National Planning and Monitoring, 2015).

The trip provided me with the opportunity to visit a small number of rural and urban schemes where I was able to witness some of the challenges first hand – some snaps are included.

Water PNG has a mandate to promote access to water and sanitation in rural areas but has largely been inactive due to its urban priorities, where service provision is struggling to keep up with rapid urban population expansion. As a consequence, the majority of water and sanitation services are provided by Non-Governmental Organisations. However, a lack of funding and the absence of a clear co-ordinated approach has limited their effectiveness.

To address these gaps, the PNG government has this year launched a National Water and Sanitation and Hygiene Policy outlining strategies to accelerate access to water and sanitation services to an additional 453,000 people by 2030.

The World Bank has estimated an investment of $kina 302,000,000 ($156,680,000) a year will be required to meet the targets outlined in the WASH Policy. Significant growth in human resources and capacity will also be required.

As with other areas of the Pacific, the scale and complexity of these challenges poses enormous opportunities for New Zealand companies and professionals to expand their services and improve the quality of life for our Pacific Island neighbours. **WNZ**

REFLECTIONS ON WATER STORAGE

From Assyrian canals to dripping taps, **Kevin McFarlane** muses on 3000 years of water management.

I have had two conversations regarding water with my kids recently. First, my 12-year old daughter (who starts many conversations with "Dad, did you know...") told me the Assyrians invented aqueducts many centuries before the Romans.

I raised a questioning eyebrow. Surely the Romans developed that idea? After all, the Roman Empire constructed many spectacular civil engineering wonders, such as the 49m high Pont Du Gard in Southern France that is still standing two millennia later.

However, I checked; my daughter was correct. It would appear that the Assyrian Empire engineered the first sophisticated long-distance canal systems in the 9th century BCE. The much celebrated and ubiquitous Romans built their first aqueduct to serve Rome with the marvelous 16km long Aqua Appia in approximately 300 BCE, some 600 years after the indigenous Middle Easterners.

Second, my son told me the shower-head was dripping. He is 14 and not particularly adept at DIY. I showed him how to insert a new washer that cost about 50c. The leak was fixed. My son was duly impressed and he learnt something new.

Water management has been an issue for engineers to address for at least three thousand years. Yet after all that time and gathering of engineering and scientific knowledge, there are still areas of the planet – habitable areas – where water storage and management is a significant problem. The Earth's climatic change is compounding the issue. President Obama, speaking in Alaska recently, stated that:

"Our understanding of climate change advances each day. Human activity is disrupting the climate, in many ways faster than we previously thought. The science is stark. It is sharpening. It proves that this once-distant threat is now very much in the present."

Is the planet slowly, but noticeably drying up?

Well, currently the Earth is a blue, extremely wet place. Some say (with tongue in cheek) that the wettest place on the planet is at the bottom of the Pacific Ocean in the 11-kilometre-deep Mariana Trench. The highly respected Guinness Book of World Records says the wettest place on land is in Mawsynram in India. Here, water vapour coming from the Bay of Bengal, condenses in the Khasi Hills by the plains of Bangladesh. The result is a humungous average annual rainfall of 11.871m. Bizarrely, though, the locals have a problem in accessing drinking water all year round.

In the dry winter months (December to February) very little rain falls. The volume of rainfall in the wet season water in Mawsynram is extremely damaging too – bridges,

roads and other infrastructure get washed out. Agriculture becomes difficult with inundation and flooding. One wonders why water isn't collected in tanks during the wet season for metaphorically (dare I say it) "a rainy day"? I imagine the issue will be the affordability of large plastic (or other) containers for the villagers to install? Surely a solution exists?

In the 21st Century, water storage has actually become a standard unit of measure for western journalists who frequently use the volume of an Olympic Swimming Pool (OSP - with requisite dimensions of 25 metres wide by a minimum two metres deep by 50 metres long), when trying to paint a picture of the size of something large. For example, I live near Melbourne and the Melbourne Cricket Ground (MCG) was recently surveyed using the latest spatial surveying technology. Its volume of 1.7 million cubic metres is equivalent (according to one excited TV journalist) to 680 OSPs.

With regards to water storage and use on a personal level, I live in a 'typical' Australian family home with a 38,000 litre swimming pool and a 2000 litre plastic water tank that collects 'grey' water – i.e. the rain falling on the roof. We use that stored grey water for irrigation of our climate-friendly-garden in the drier summer months, where indigenous plants reign supreme as temperatures reach the low 40s Celsius. Our pool gets a regular top up, but we pay for that privilege, and keep the pool covered when it's not in use to reduce evaporation.

Dotted all over the rural Victorian landscape are oval or circular ponds (normally surrounded by sheep or cattle) that store much needed rainwater for farming. Like many countries, Australia suffers with drought and has to occasionally restrict water usage. Relatively speaking, our recent dry 2015 winter means the state authorities are already preparing for what they expect will be a bad bushfire season.

At home, we use a dishwasher to minimize water use and only turn that on when it's full of dirty crockery and cutlery. A recent study by the University of Bonn stated that on average 10.5 litres of water is used per person, each day, when washing the "normal" amount of dishes by hand. One dishwasher manufacturer stated that its best dishwashers use only 2.3 litres of water (22 percent) to wash the same amount of dishes (per person, per day). Their labour-saving appliances also (they claim) require less energy to heat the smaller amount of water.

In the northern hemisphere, the thirsty Californians have been experiencing the fourth year of a record-breaking drought which is creating an extremely parched landscape. Governor Jerry Brown declared a drought "State of Emergency" in January of this year and imposed strict conservation measures state-wide. In August this year, the California Department of Water Resources (DWR) announced two new rebate programs to help Californians replace inefficient toilets and to remove water-guzzling lawns to conserve water during the historic on-going drought.

Technology and the 'information age' can deliver useful information to us at the touch of a screen. For example, the Australian Bureau of Meteorology (BOM) website allows one to; "Compare water storage levels and volumes for more than 300 publicly-owned lakes, reservoirs and weirs in different states and territories and to see how much water is available over the entire country. The data therein also enables one to compare how the volume of water in storage has changed over the previous, day, week, month and year.

Australia reportedly has around 500 publicly-owned water storages according to BOM. Of those, more than 250 major storages have a capacity greater than one gigalitre (1,000,000,000 litres or 400 OSPs).

I wonder what the Assyrians and Romans would be suggesting with regards to water management if they were here now? Maybe they would either be praying to the appropriate gods for divine intervention, or put their inventive helmets on? It seems that some inhabitants on this planet have too much rain; others don't have enough.

Water storage is something that we must, surely, continue to understand, develop and consider at a personal, local, regional and national level. I have already given some simple examples of what we can do as individuals from efficient garden irrigation to washing up, from flushing efficient toilets to fixing small leaks. It's a cliché, but if everyone plays a small part, the collective benefit will be measurable. It might even show up on BOM's website? **WNZ**

PUMPING UP
our freshwater goals

By **Helen Atkins,** partner, **Vicki Morrison-Shaw,** senior associate; and **Phoebe Mason,** solicitor – Atkins Holm Majurey

There is nothing quite like the feeling of being fresh and clean or in the words of Outkast "Ain't nobody dope as me, I'm dressed so fresh so clean (so fresh and so clean clean)". Having fresh clean waterways is something we all want and there are a number of recent developments which should assist in that goal.

The Ministry for the Environment (MfE) is in the process of revising a National Direction on environmental issues including freshwater; a revised Environmental Reporting Act 2015 has been passed to enable data on the state of the environment to be accurately and consistently recorded; Local Government New Zealand (LGNZ) and the Iwi Chairs Forum have signed a Memorandum of Understanding (MOU) on matters including the environment; and the Courts are considering whether animal excrement is a discharge requiring consent.

For all intents and purposes, freshwater controls and monitoring are being pumped up to achieve the goal of fresh, clean, swimmable rivers and lakes, a matter at the forefront of New Zealanders' minds with summer on the way.

Increased National Direction

On 13 August 2015, at the Environmental Defence Society's conference in Auckland, Environment Minister Nick Smith announced a 'stepped up' programme of National Policy Statements, National Environmental Standards and national guidance "to get better environmental results at less cost". This involved the release of two documents – the Ministries for the Environment and Primary Industries' guide on implementing the National Policy Statement for Freshwater Management 2014; and 'A Way Forward for National Direction', an overview of the MfE's priority topics.

On freshwater, the minister stressed that the Government's focus was not only on improving freshwater quality, but about making use of NZs freshwater resources for regional development. The minister "challenge[d] those who argue irrigation schemes are synonymous with degradation of water quality and only about dairying."

The MfE's current priority topics, warranting National Environmental Standards, National Policy Statements, or 'guidance' in the next two years, are: telecommunication facilities; plantation forestry; urban development; freshwater management; biodiversity; pest control and eradication; air; aquaculture; contaminants in soil; and natural hazards. Them minister also announced that the Government would be developing a long-term environmental science strategy. The full documents can be found here: http://beehive.govt.nz/release/bluegreen-programme-improved-environmental-management-outlined.

Environmental Reporting

The Environmental Reporting Act 2015 was passed into law on 28 September 2015. The purpose of the Act is to require regular reports on New Zealand's environment. The Act sets out:

Is cow poo just excrement – or is it a discharge that requires a permit? Two legal cases test that particular water (page 58).

- Who has responsibilities for environmental reporting – the Government Statistician and the Secretary for the Environment;
- The environmental reporting framework – the environment comprising the five domains of air, atmosphere and climate, land, freshwater and marine; and the framework to include information about pressures, states and impacts;
- The timeframes in which the reports must be produced – one domain is required to be reported on every six months with a full report on all domains required once every three years.

The Act will come into force at the earlier of a date appointed by the Governor General or by the end of June 2016.

LGNZ and Iwi Chairs Forum MOU

On 6 August 2015, LGNZ and the Iwi Chairs Forum signed an MOU. The purpose of the MOU was to set out how the groups would work together for the benefit of their various members and stakeholders on matters of strategic significance. These matters include economic development, the environment, infrastructure, employment, social issues, health, housing and energy as well as local democratic representation and decision making.

The MOU also signals that there may be other relationship documents entered into between the parties. In particular, the MOU anticipates that the regional sector group of LGNZ will have a relationship with the freshwater Iwi Leaders Group centred on regional council matters especially freshwater.

In late September, we spoke about the MOU with LGNZ President Lawrence Yule who says LGNZ is honoured to have an MOU with the Iwi Chairs Forum and that it is the first non-government agency to do so. While noting that many local authorities had MOUs with Iwi in their respective areas, Yule notes there is a fundamentally different relationship between a national organisation like LGNZ and Iwi. The MOU covers all matters of strategic significance to LGNZ and the Iwi Chairs Forum at a national level and is not constrained by any particular piece of legislation. He notes, for example, that the MOU is not limited to freshwater but also covers matters such as post-Treaty settlement lands, Department of Conservation land estates, and housing affordability.

In terms of freshwater, Yule says the MOU formalises the relationships and indicates who will have a relationship with whom – i.e. the LGNZ Regional Sector Group and the freshwater Iwi Leaders Group.

In response to questions regarding how he sees the MOU working in practice and what steps LGNZ will be taking to give effect to the MOU relationship, Yule says that LGNZ is currently working on these matters as part of the next (implementation) stage. He confirms that giving effect to the MOU is a strategic priority for LGNZ, and while further resourcing is likely to be required, he expects a clear work programme to be in place for all of the matters of strategic significance by the end of the year.

Recent cases

Two recent cases have dealt in part with a rather interesting question and that is whether animal excrement is a discharge requiring consent under s15, RMA. We discuss these below.

P E Limited v Canterbury Regional Council [2015] NZEnvC 106

This case was a procedural decision by Judge Jackson in relation to water permits in the Canterbury High Country. The procedural question was whether the Court should hear evidence about the probability and consequences of the downstream effects of the proposed irrigation. The decision is interesting for a number of reasons, but most particularly for the Court discussion around whether a resource consent is required under s15 of the Resource Management Act 1991 ("RMA") for stock "urinating and defecating" on land. While the Court was not required to decide this issue, it indicated that the answer would depend on the circumstances of a particular case, but that where there is an intensive farming use (such as dairy) a consent may be required:

[35] The question whether allowing large numbers of stock to urinate and defecate on land is caught by section 15 RMA and rule 5.63 has not yet been definitively ruled on by the Environment Court or a superior authority. That may be because the issue is simply a question of application to be answered in a particular different context in every situation. In case it assists, we add a few observations.

[36] First, the provision by Parliament of a long and careful definition of "discharge" in section 2 RMA suggests to us that the legislature intends any question of whether an activity comes within section 15 of the RMA to be a matter of application of the definition … not a question of interpretation…

[37]Second, both the application of section 15 to stock emissions of urine and the pLWRP rule seem to be consistent with the National Policy Statement on Freshwater Management ("NPSFM 2014"). Policy A4 includes policies about discharge in all regional plans and then states…

3. This policy applies to the following discharges (including a diffuse discharge by any person or animal)…

This seems to contemplate that allowing stock to urinate onto the ground is a discharge, although we are unsure what is contemplated by "diffuse". The NPSFM 2014 is an important document and must be given effect to as confirmed by the Supreme Court in Environmental Defence Society v New Zealand King Salmon.

[38] Third, in *Marlborough District Council v Awarua Farm (Marlborough) Limited*, the Environment Court considered an application for enforcement orders in relation to a dairy farming operation. It stated (obiter):

We would accept the general proposition that the evacuation of the bladder or bowels of stock is generally regarded as a non-point discharge which is not controlled by the Act. The reasoning would be that the owner has neither intended nor permitted the activity, but it is a natural occurrence.

There seems to be a logical disconnection in that passage. If a subsequent "natural process" changing the chemical composition of a contaminant does not alter its status as a contaminant - and the definition in section 2 RMA expressly says so - then why should the initial emission not be seen as a discharge in the sense of "allow to escape", especially when urinating and defecating are also described by the court as "natural occurrences?" We respectfully doubt whether the Environment Court was correct in that decision. We should note that the questioned passage was affirmed by the High Court in *Awarua Farm (Marlborough) Limited v Marlborough District Council* although that seems to be obiter also or possibly, as Mr Anderson submitted, per incuriam.

The decision is also worth a read simply for the rather dramatic turn of phrase used by the Court to describe a couple of the issues. In finding that a "remoteness limit" applied to the term "any adverse effects" under s 104(1)(a) the Court stated:

[42] In particular there must be some kind of remoteness limit. Given that the concept of causation is endless – effects continue remotely to infinity or at least until our local star obliterates the earth – it is practically impossible to consider all the effects of any activity. Truly remote possible effects simply get lost in the waves and backwash of other events… [Our emphasis]

And in finding that section 7(b) reminds a consent authority to take costs and benefits into account, and provides a useful 'back-up test,' the Court stated:

[55] … We can explain what we mean by a back-up as follows. The ultimate question for the consent authority is always whether, after considering and weighing all relevant factors, the purpose of the RMA, usually particularised in the relevant regional plans, is better met by granting or refusing consent. Not exaggerating unduly, the consent authority may sometimes find itself having to choose what is appropriate by locating a point on a very long line between a dystopic hell of unsustainable use (if the case put forward by the opponents of a proposal is to be accepted), and a platonic elysium of sustainable management (as put forward by its proponents). In such cases the section 7 (b) comparison of the net benefits to the public of the proposal versus the next best option (usually, but not necessarily the status quo) can be a grounding contribution to the overall analysis. [Our emphasis]

Royal Forest and Bird Protection Society of New Zealand Incorporated v Canterbury Regional Council [2015] NZHC 2058

This was a procedural decision of the High Court in response to an application for directions as to service of declaration proceedings instigated by the Royal Forest and Bird Protection Society. The declarations sought by Forest and Bird all essentially related to the issue of how animal excrement is dealt with under the RMA and to what extent it can be regarded as a discharge. Three declarations were sought in the following terms.

(a) Where a person uses land for livestock farming, the deposition of excreta by the livestock to land, in circumstances where contaminants from the excreta may enter water, is a discharge for the purposes of s 15(1) of the Resource Management Act 1991 (the RMA).

(b) Where a person uses land for livestock farming, the deposition of excreta by the livestock to land, in circumstances where contaminants from the excreta may enter water, is a discharge for the purposes of the National Policy on Freshwater Management 2014.

(c) On land supplied with water from an irrigation scheme in the Selwyn Te Waihora sub region, the direct deposition by livestock of excreta in circumstances where contaminants may enter water is a discharge for the purposes of rr 11.5.15 and 11.5.15A of Variation 1 of the Proposed Canterbury Land and Water Regional Plan.

The Court gave directions to serve all regional councils, Federated Farmers, Fonterra, Synlait, Central Plains Water, Te Runanga o Ngai Tahu, the Ministry for the Environment and the Fish and Game Council with a copy of the proceedings.

The Court did, however, recognise that there may be other parties "whose interests are affected greater than the public generally" and the Court noted that any such parties can make an application to join the proceedings. Given the widespread potential effect of such declarations, this will be a case to watch and we will report further in future articles on the progression of this case. **WNZ**

Envirolyte – a smart solution

In 2012, wastewater treatment in the town of Maketu in the Western Bay of Plenty was upgraded with a new pressure sewer, a sequencing batch reactor and 4.2 hectares of sub-surface drip irrigation.

Just one year following its commissioning, the land disposal system was in a bad way.

Dripline emitters were so blocked that flow rates were down to just three percent of the design flow, the automatic field filters were in a state of constant backwash cycles (causing localised ponding), and the level of operator intervention required just to keep the disposal system operational was enormous.

A series of sodium hypochlorite washes in 2013 and 2014 was able to restore flow rates to almost full flow, however attempting to maintain that flow was even more labour intensive with the filters being stripped daily and filter screens needing to be being manually cleaned with a water blaster.

The operators also had concerns over the Health and Safety aspects of the repeated sodium hypochlorite washes.

In July 2015, Ecogent proposed a three-month trial of an Envirolyte machine at the treatment plant. The Envirolyte machine applies a direct current to a brine solution and separates the constituent sodium and chlorine ions. The solution formed at the anode cell is known as Anolyte and is a chlorine-based solution containing various forms of the chlorine ion but, in particular, hypochlorous acid which is an extremely effective bactericide.

Hypochlorous acid is 100 times more effective at killing micro-organisms than hypochlorite and completely harmless to the environment, humans and animals (multiple MPI food safety approvals).

The Envirolyte machine produces the hypochlorous on site (right where it's needed) from table salt and water. The Anolyte is continuously dosed into the treated effluent upstream of the main filter at the irrigation pump, at a rate of just one percent of the total flow to the disposal.

The Anolyte has worked away at the residual algae and biomass accumulated on filter screens, dripline emitters and valve apertures gradually reducing the accumulation and eliminating the growth. The three-month trial demonstrated the following benefits:

- Full design flow was restored to the irrigation field;
- The main filter screen returned to an as new appearance and remain virtually spotless and without the need for manual cleaning;
- The field filters now only auto backwash occasionally;
- There are no wet areas in the disposal field;
- The disposal system operates in automatic mode without the need for operator intervention; and
- Health & Safety concerns were eliminated.

The results were quickly evident, according to Adrian Webb, operations team leader with the Western Bay of Plenty District Council (WBPDC).

"The results were noticeable within the first month of the trial with the primary filter found to be remarkably clean."

Filter trial before (top) and after (above).

At the end of the trial, WBPDC purchased the machine for a permanent installation. As a side benefit to the permanent install, the operator was able to fog the Anolyte solution into the sludge press room which significantly reduced the odour and flies.

Similar results have been achieved using Envirolyte at other municipal land disposal systems and there is opportunity to improve outcomes wherever nuisance biological growth affects mechanical operation. **WNZ**

Further information on the projects and on the Envirolyte machines can be obtained by contacting Ecogent or Envirolyte NZ.

SLUDGE MEASUREMENT – optimising wastewater treatment

The removal of sludge is one of the most critical challenges in the creation of good-quality effluent from wastewater treatment plants. **Carlo Gorissen** from Teltherm explains why and how measuring and monitoring sludge can provide optimum efficiency for the process.

Apart from lessening the environmental impact of human waste, modern wastewater treatment plants (WWTP) have embraced advances in science and technology that allow significant, positive inputs, such as energy for the plant (eg. biogas such as methane) and in some cases even revenue streams from processed bio solids (eg. nutrient-rich fertilizer for farming).

In order for these advanced systems to work effectively, one of the most crucial parameters for plant operators to monitor is the total solids or sludge as it moves through the plant.

Why is sludge measurement so important?

Although the composition and concentration of sludge varies throughout the treatment pathway (primary, secondary and even tertiary stages), understanding the settling characteristics of sludge is critical if the plant is to optimize control. Primary sedimentation, biological stages, secondary treatment, effluent quality and subsequent sludge handling are all greatly affected by how well the settling has been achieved and, importantly, monitored.

By measuring sludge levels in both primary and secondary sedimentation tanks, operators may be able to ensure sludge extraction pumps are used efficiently and excess poorly settled sludge doesn't wash out into effluent paths.

By measuring sludge levels, operators can study sedimentation characteristics of suspended solids in the plant, understand sensitivities due to disturbances, and manage sludge levels to allow sufficient buffering for incoming hydraulic load variations. During periods of high hydraulic loading (eg. after a storm), poor-quality or slowly settling 'fluff' sludge is at risk of removal. This will cause more rapid clogging of sand filters, which increases the need for backwashing, thereby increasing pump loads and electricity usage. If sand filters are not present, it could lead to expensive failure of effluent quality.

Further sludge-handling processes such as thickeners and dewatering equipment will all perform better when fed with higher-concentration total solids sludge.

More diluted, lower-concentration sludge will require:

- the increased dosing of expensive polymer dosing thickeners;
- increased heating costs of digesters;
- require more chemical and mechanical processing in dewatered stages; and
- increased pumping costs to send the reject water volume from the steps above for reprocessing.

By measuring the actual height of a given total suspended solids concentration in sedimentation tanks, an operator can ensure they only extract and waste the desired higher concentration of sludge, leaving lower concentrations to remain for additional sedimentation.

Why automate?

While no two WWTPs are identical, the push to improve efficiency through automation and improved process control is a common theme.

Aside from obvious labour savings, relying solely on manual sampling means that thorough analysis of plant characteristics and trends is limited to the frequency of sampling.

In a WWTP with continuous, automatic measurement of critical process variables, there is a wealth of feedback which creates a robustness of system control, capable of rapidly identifying disturbances or operational problems.

Sludge blanket level measuring

In the early 1980s, Cerlic first patented near infrared (NIR) transmission of light (optical) sensors for measuring suspended solids concentrations.

Unlike existing turbidity sensors, NIR sensors are immune to changes in particle shape and reflectivity and don't require colour compensation or other indirect assumptions to measure concentrations.

With NIR technology, only particles over a certain size (40 µm) will block the transmission of the specific wavelength (880 nm) – this means sensors can provide a direct measurement of suspended solids concentration in mg/L, parts per million (ppm) or % TSS (suspended solids concentration).

In 2008, the CBX sludge blanket meter was specifically designed to accurately measure the level of floating fluff (unsettled sludge) and sludge level, along with the full sludge profile within a sedimentation tank.

How the sludge blanket meter works

Following an input signal such as the passing of a rake, the sensor is automatically lowered into the sedimentation tank as it continuously measures the suspended solids concentration as a function of the sensor depth (up to 10 m). Like a yoyo, the optical sensor is then retracted back into the CBX enclosure. As the cable and sensor are retracted, they are automatically sprayed clean with pressurized water to prevent the need for manual cleaning by operators.

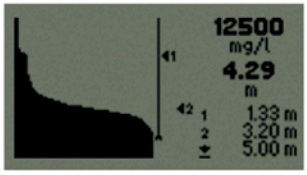
Unlike ultrasonic sludge blanket sensors that have their echo calibrated to a certain density which is indirectly related to the level of sludge, the CBX is programmed by operators with TSS concentrations that correlate to the desired fluff and sludge concentrations required to prevent suspended solids extraction in effluent and optimize sludge concentration for extraction.

As the sensor is lowered, it directly reads suspended solids concentration, reporting back (4-20 mA or Profibus DP) the level at which each of the target concentrations has been found. This means that changes in fluff, sludge density and the presence of tank scrapers don't impede readings or introduce the need for further filtering correction (such as averaging).

Examples how sludge profiles may vary:

CBX system.

As real-time depth versus concentration is measured, both the sensor's local display and a WWTP SCADA control system are able to plot a full sludge profile through the entire tank (see Examples how sludge profiles may vary).



SEE THEM IN ACTION!

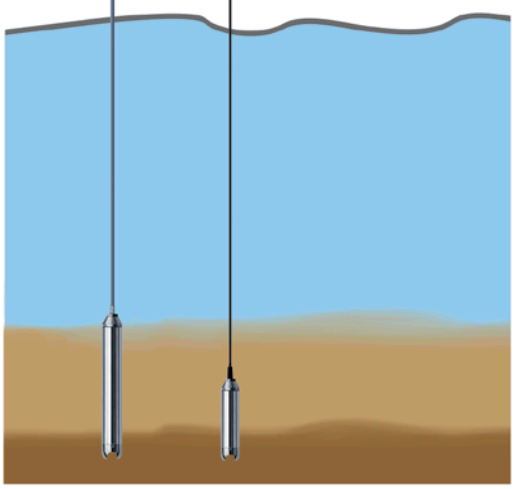
See the sludge level...

PROVEN NEAR INFRARED (NIR) TECHNOLOGY
- Directly measures total suspended solids concentration (mg/L, ppm or %TSS)
- Choice of 2% or up to 5% TSS (e.g. primary or thickened sludge) models
- Not an indirect, compensated ultrasonic echo or turbidity sensor

FULLY AUTOMATIC (MOTORISED) CBX
- Measure Sludge Blanket & Fluff (unsettled or rising solids) when triggered by rake, SCADA or timer
- Real-time TSS concentration vs depth for full sludge profile
- Continuous 4-20mA or Profibus DP (including temperature)
- Tilt switch for tangle prevention & self-cleaning (cable + sensor) for low maintenance

HANDHELD MULTITRACKER UNIT
- Plug 'n play Sludge Blanket Profile, DO & RAS / WAS (5% TSS)
- Backlight display, datalogging (with PC sync) & alarm points

...rather than trying to hear it!



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Glass Fused to Steel (GFS) technology is repeatedly proven to be the recognised premium choice of coating above and beyond any other coating solution available in the global bolted steel tank market.

Bolted GFS tanks are used worldwide in the storage and treatment of drinking water, wastewater, process water, agricultural effluents, and aggressive applications of industrial effluent, municipal waste, leachate and mining sector markets.

Glass coatings are designed to produce an extremely strong chemical bond to the steel during the fusion process. This places the glass in compression and it remains in compression even when the steel bends and flexes.

GFS coatings are designed to deliver strength and durability while the steel is in tension due to the contents load. Unlike fusion-bonded epoxy coating systems that are merely 'baked' on the steel surface and only form a physical bond, GFS coatings are both chemically fused to and physically combined with the steel substrate.

This results in an unmatched, tough and durable bond. A number of competitive tank manufacturers using epoxy coating systems, use the term "fusion bonded" or "fusing". In order for there to be fusion of two materials, there must be a chemical bond at a molecular level.

A typical factory-applied "fusion bonded" epoxy is cured at a much lower temperature typically 200°C - 275°C (390°F- 525°F) which makes fusion between the epoxy and steel impossible. This results in an epoxy coating which is typically susceptible to damage, delamination and ultimately corrosion.

So what are the benefits?

GFS coatings are silica rich and use blends of compounds to produce inert, inorganic UV stable and colourfast finishes making our product suitable for high-temperature regions.

GFS coatings deliver exceptional resistance to chemical corrosion and provide excellent physical and chemical resistance properties to the final product.

In the municipal water market, there are GFS structures that have been in service for over 45 years, with routine inspection and maintenance, and are still in good operating condition. This is testament to the longevity of the GFS coatings. With advances in manufacturing processes and material enhancements, combined with improved safety in design, it is not unrealistic to expect a service life greatly exceeding 80 years.

Find out more of the technical features of Glass Fused to Steel coatings at www.gfs-coatings.co.nz

Glass fused to steel - the long-lasting storage option

SENIOR APPOINTMENTS AT BECA

Beca's water networks team has strengthened its leadership with the recent appointments of **Andy Gibson**, Business Director - Network Planning, and **Dan Stevens,** Business Director - Water. These senior appointments are a testament to the recent growth experienced by Beca in the water sector.

Andy Gibson

Andy emigrated from the UK in 2005 and will be based in the Christchurch office. He has over 20 years' experience in the water sector, including extensive experience in modeling major trunk sewer systems and has developed asset management approaches for the likes of Stronger Christchurch Infrastructure Rebuild Team (SCIRT) and Watercare's Central Interceptor project.

Dan Stevens

Dan is a nationally recognised expert in the planning of water supply networks, having had early involvement in the development of water network modeling software with HR Wallingford in the UK. He has worked in New Zealand for the last 10 years and has developed strong client relationships across Australasia. He will also be based in Christchurch, focusing on water distribution, water network planning and operational optimisation.

CH2M WINS 2015 STOCKHOLM INDUSTRY WATER AWARD

The Stockholm International Water Institute has selected CH2M as the recipient of the 2015 Stockholm Industry Water Award (SIWA) for developing and advancing methods to clean water and increasing public acceptance of recycled water. Given annually, the award honors outstanding and transformative water achievements by companies that contribute to sustainable water management.

CH2M has long recognised that the global community cannot afford to use wastewater once and dispose of it, particularly with fresh water sources growing scarcer.

"Purifying wastewater effluent to create drinking water is the logical solution," says Greg McIntyre, CH2M Global Water Business Group President. "Our firm has been at the forefront of removing technical and public acceptance hurdles – turning one of our world's great resource challenges into an opportunity to get water reuse projects up and running, and ensure our world has access to long-term water supplies for centuries to come."

"We're proud to accept this award which reflects the outstanding work we've done with our clients around the world to revolutionize the way water is treated and accepted."

Today, CH2M continues to make progress in advancing water reuse technologies, working on two landmark potable reuse projects in Australia, including the Western Corridor Recycled Water Project in Southeast Queensland and the Beenyup Groundwater Replenishment Plant in Perth.

"Decades of water innovation have laid the foundation for a sustainable water future" says Greg McIntyre, CH2M Global Water Business Group President. "Embracing that future will require a widespread understanding that water must be judged by its quality and not its history, as well as the knowledge that all water is used and reused as part of the urban water cycle."

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