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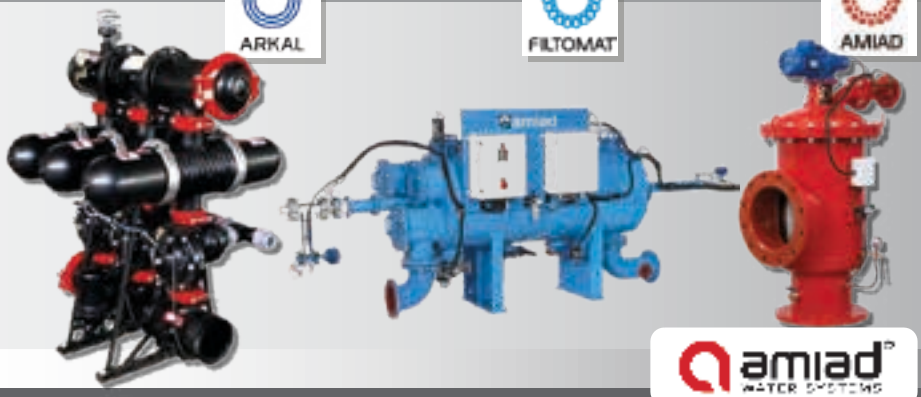

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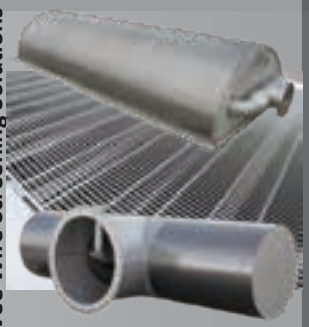

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WATER JOURNAL
Managing Editor: Alan Titchall
P +64 9 636 5712, M +64 27 405 0338
alan@contrafed.co.nz
Contrafed Publishing
Contributors: Mary Searle Bell
Advertising Sales: Noeline Strange
P: +64 9 528 8009, M: +64 27 207 6511
n.strange@xtra.co.nz
Design: Contrafed Publishing
Suite 2,1, 93 Dominion Rd
PO Box 112357, Penrose, Auckland, 1642
P: +64 9 636 5715
www.contrafed.co.nz
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Issue 205 JULY / AUGUST 2018

INSIDE

FEATURES

REGULARS

A consistent approach across the 3 waters sector.

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.

Preparing for coming reform

Dukessa Blackburn-Huettner,
President, Water New Zealand

We were very fortunate to have the Minister for Local Government, Nanaia Mahuta, speak at our Stormwater Conference in Queenstown in May and to join us later for dinner. The Minister spoke about the importance of water, the challenges ahead, and outlined the current review of the water industry.

She again joined us at the Water Summit in Wellington where she iterated the need for reform in order to lift the capability of the sector and to provide a more sustainable funding model. The Minister made it clear that there are no "pre-determined solutions", but that there is a need to consider the best means of upgrading our water infrastructure to ensure it meets quality public health and environmental outcomes.

Water New Zealand has set up a working group to advise the government on technical aspects of the recommendations arising out of the review.

Some of the key problems facing councils that the review has confirmed include: funding infrastructure in high growth areas; declining populations and rating bases; struggling to respond to climate change; failure to meet community expectations, and small towns having to support a large tourist base.

The report of the Havelock North Drinking Water Inquiry has also demonstrated that in the drinking water space there are systemic problems which also require a major fix.

Putting aside the details, the issues now identified in the Cabinet paper before the Government (available on the DIA and Water New Zealand websites) deals with a number of key issues:

- There is a lack of central government oversight of three waters delivery which suggests the need for a new regulator;
- The number of entities delivering water services – this suggests that the Government should consider what alternatives might be possible, including establishing a licencing regime for suppliers;
- There is a lack of transparency and accountability around decision-making by councils – suggesting a more rigorous information disclosure regime is warranted;
- Are there alternative ways to fund three waters services?

One of the big issues that is being focused on is whether the Government intends to mandate compulsory treatment of public water supplies. It's an issue being played out in Christchurch and other communities like Lake Hayes, Geraldine and Glenorchy. While important, this is actually one of many technical issues dealt with by the Inquiry report that will be resolved in due course.

As we head toward Government decisions on the broader issues listed above, we at Water New Zealand recognise that this is a political decision and also that there is not one "solution" which we are pushing. As we have over the past few years, we see our role as ensuring that officials are aware of the options based on the evidence, and what the implications of certain choices might be. Everyone agrees the issues are complex. If it were easy the decisions would have been made years ago.

On the regulatory front the options seem to be around whether the Government should establish a stand-alone regulator, or include the function into that of an existing agency? Should the Government regulate just drinking water or include waste water as well? What should happen with stormwater or is it sufficiently well-regulated via the RMA?

We strongly believe that protecting public safety and providing safe drinking water are of paramount importance. Therefore it is vital to ensure that public water supplies are treated, unless, as the Havelock Inquiry recommended, there are "exceptional circumstances".

The question of how many councils or "entities" should deliver water services has always been the hard issue to resolve. There actually isn't a "right" answer. There is a competition of ideas in this space and it depends on your point of view. There are plenty of good overseas examples and learnings that can be considered. For Water New Zealand it is important that we take the learnings and weigh up the pros and cons. We also hope that New Zealand's uniqueness and tangata whenua relationship to land and water is preserved in whatever model is adopted.

One option is the one company model, with Scottish Water or TasWater in Tasmania as examples. Another option could be that the function could be transferred to Regional Councils to deliver. Perhaps a Watercare or Wellington Water model with three to five companies is the right approach. Or maybe the status quo with improved regulatory oversight, information disclosure and ring-fenced funding will do the trick. Some think an asset owning model is essential, others not.

Any of these will work, some better than others. It actually isn't our job at Water New Zealand to provide Government

with a solution. In some respects any change is better than the status quo.

It was with this in mind that Water New Zealand brought two international experts to speak to the Water Summit in May.

Marcus Rink spoke about the regulatory model in the UK while TasWater CEO, Mike Brewster, talked of the reform process in Tasmania. (You can read more about what they had to say in the following pages of this publication).

We often hear that local government can't afford to make the changes the Government is proposing without central government help. While that may well be correct, as a country I suspect we can well afford to maintain and upgrade our three waters infrastructure. It was built and paid for when this country had one million people. Now we have approaching five million, most with a substantially higher level of wealth.

As the Government moves to make in-principle decisions toward the end of this year, it's important we approach this reform with an open mind. The issue is bigger and more important than whether our jobs as individuals will change.

There will be challenges about whether what is left with local government makes economic sense if the Government removes three waters services and transfers the assets to stand alone entities. Perhaps if Government also takes the debt off their balance sheets they may welcome the move.

The Government has committed to examining local government funding through a review by the Productivity Commission. These are opportunities for us all to argue for a direct transfer of tax revenue to local government to support localism. We remain one of the few western countries where local government is funded almost exclusively from local rates. Time for a change perhaps? **WNZ**

UPCOMING EVENTS

Civil Contractors NZ/ACENZ	1 – 4 August	Claudelands, Hamilton
Infrastructure New Zealand Building Nations Symposium	16 – 17 August	ANZ Viaduct Events Centre, Auckland
Pacific Water and Wastes Association	6 – 10 August	Noumea
Water Industry Operators Association Australia	3 – 7 September	Bendigo, Australia
Water New Zealand Conference	19 – 21 September	Claudelands, Hamilton

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Last minute nominations for Water New Zealand 2018 awards

Water New Zealand's annual awards are a great opportunity to show support for the professionalism of our sector and acknowledge the efforts of individuals and teams.

If you're quick there's still time to get your entries or nominations in.

KEY AWARDS INCLUDE:

Hynds Paper of the Year – for the best technical paper

Hynds Presentation of the Year – best presented paper (nominations not required)

CH2M Beca Young Water Professional Award – for exceptional achievement in early stage of career

ProjectMax Young Author of the Year – encouraging participation of young authors

Ronald Hicks Memorial Award – for an article or paper solving or clarifying sewage treatment or water pollution problems in New Zealand

IXOM Operations prize – for best practice with strong operations flavour

Veolia Health and Safety Award – recognises elimination or minimisation of a health and safety risk.

Pipeline and Civil Project Award – recognised excellence in delivery of a project

Opus Trainee of the Year– recognises a keen desire to advance a career in the water industry

Poster of the Year – for the best poster presented at the conference

5S YWP Conference Attendance Prize – providing young water professionals the opportunity to broaden their knowledge in the water industry

For criteria and entry information contact: amy.aldrich@waternz.org.nz or go to: www.waternz.org.nz/awards

Operations *challenge*

Test yourself and your team mates in three challenges.

The Operations Challenge was so successful last year, we're doing it again – at this year's Water New Zealand Conference.

The challenge showcases teamwork and collaboration – essential ingredients in the water sector. It's also lots of fun.

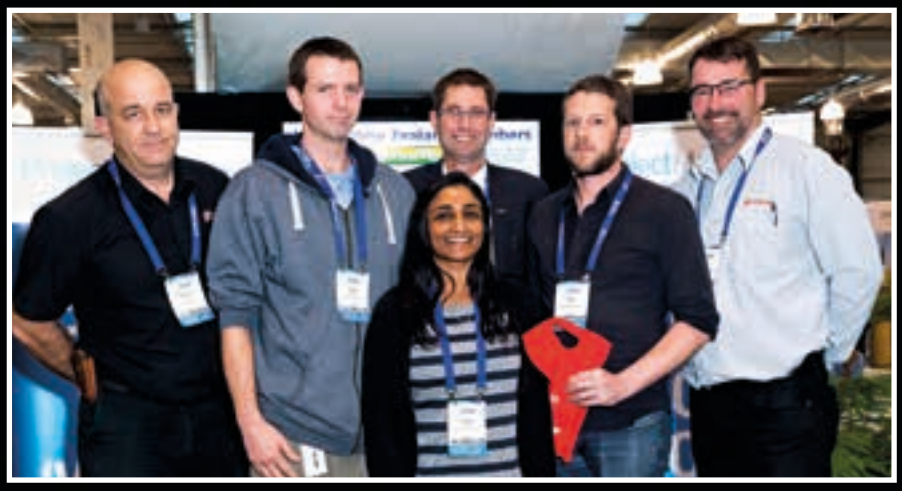
Last year it was a close race to the finish line. The ultimate winner, Hamilton City Council's "Ace of Assets" beat City Care by just one point, so competition is tight and the Operations Challenge is set to be one of the highlight events at the conference.

So make sure you get a team together and test your problem-solving skills against three challenges worth 50 points each:

Health and safety – solve a practical team problem;

General water knowledge quiz – multi-choice test of combined knowledge and application of design principles;

Practical test – undertake a typical reticulation type task.



Last year's winning Team "Aces of Assets" from Hamilton City Council managed a winning score of 132/150. Pictured (left to right): Richard (Safety N Action), Evan Vaughters, Parvati Patel (both of Hamilton CC), Brent Manning (event co-ordinator), Mark Marr (HCC) and representing key activity sponsor Veolia; Keith Martin.

For more information and to sign up go to www.waternzconference.org.nz

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Celebrating 60 years of dammed water

Our electricity industry, supported and funded by the Government, achieved world-leading feats of engineering and power supply in its early stages at the turn of the 20th century. It was this work damming rivers that gave us such an enviable renewable generation portfolio today.

PHOTOS COURTESY OF: ALEXANDER TURNBULL LIBRARY, WELLINGTON.

Our electricity industry, supported and funded by the Government, achieved world-leading feats of engineering and power supply in its early stages at the turn of the 20th century.

It was this work damming rivers that gave us such an enviable renewable generation portfolio today.

The creation of massive state-owned hydroelectricity stations, and the people who helped make them happen, were captured in episode two of *Powering New Zealand*, which premiered to an industry audience at Rutherford House in Wellington on July 13.

Powering New Zealand is a new five-part documentary series that uncovers the untold stories of New Zealand's electricity inventors and pioneers, highlighting a wide range of electricity innovations with home-grown stories about hydroelectric power generation, the development of the electric fence, the world's first all-electric house, and more.

Documentary creators and hosts Stephen Batstone and David Reeve have drawn on their combined 40 years of experience in the electricity industry on what they call their "passion project."

"The stories and people behind New Zealand's electricity industry are fascinating – but they've largely been forgotten,"

1. Okere Falls: Part of Power station at Okere Falls in the Rotorua district.
2. Lake Coleridge: Creator unknown: Photograph of a scene at Lake Coleridge, Canterbury, including the hyroelectric power station.
3. Arapuni Dam under construction, circa 1928.

says Batstone. "These people and their stories are well worth celebrating."

Episode one of *Powering New Zealand* looks at the beginnings in Central Otago and Westland to see the Southern Hemisphere's first hydroelectric power station and the first town in New Zealand, Reefton, to be lit by electricity.

Episode two explores the beginnings of state involvement in the electricity industry and the visionary engineers behind New Zealand's hydroelectric power stations and the start of the national grid.

"In the 1900s New Zealand really led the way with government-funded, large-scale hydropower generation," says Batstone.

Following the successful development of the Southern Hemisphere's first hydroelectric power station in Bullendale, Central Otago, and the world's first electric gold dredge, Sandhills on the Upper Shotover River, the government was beginning to take notice.

"The government, at the time under Prime Minister Richard Seddon, saw an opportunity to up the ante with electricity generation – they wanted in," says Reeve.

They brought in engineer Robert Fletcher, who had been instrumental in the Bullendale and Sandhills projects, to get them started, choosing Rotorua as a guinea pig town. There, they wanted to use electric motors to run the sewage system and electric lighting to increase tourism appeal.

"Fletcher chose Okere Falls on the Kaituna River to build, and that would become one of the first government-built hydroelectric power stations in the world, and it was the Okere Falls success that convinced the Government hydroelectricity had a big role to play in building the country," says Reeve.

It resolved the New Zealand state would build only hydroelectric power stations, a policy that survived several successive governments until 1958.

"Fletcher is a big name in New Zealand's electricity history, yet we've never been able to find a photo of him, so unfortunately we can't even put a face to all the contributions he made."

According to Reeve, another electricity pioneer in the early 1900s was Glasgow-born engineer Peter Seton Hay, whose 1904 report on the rivers and lakes suited for hydropower generation is still regarded as the authority on the country's hydro catchments.

"He travelled the length of the country putting the report together, and it's still the first word and starting point for every major hydroelectric scheme in New Zealand, which is extraordinary considering it's now well over 100 years old.

"It's thanks to Hay that we have our major hydropower stations – Coleridge, Arapuni, Benmore, Karapiro, and Whakamaru, to name a few." **WNZ**

- Episode two will be available after 13 July.
- To find out when new episodes are available, and to contribute to the series, like the *Powering New Zealand* Facebook page: Facebook.com/PoweringNewZealand

The government's direction on freshwater management

Water New Zealand has been involved, through its membership with the Land and Water Forum (LAWF), in advising the Government on how to avoid further water degradation.

The Environment Minister, David Parker, has signalled that he wants to toughen up water quality standards and has sought advice from the LAWF about matters relating to the new National Policy Statement on Freshwater Management (NPS-FM) which requires regional authorities to set limits around water quantity and quality.

A number of Water New Zealand members are also involved in a work programme led by the Ministry for the Environment to develop urban good management principles aimed at supporting implementation of the NPS-FM in urban areas.

Grant Smith, Mayor of Palmerston North City Council.

We are considering how we can support members grappling with the NPS-FM. It is important that three waters sector interests are well represented in regional planning processes happening round the country.

Water New Zealand can't be active in every area submitting on regional plans. We can, however, identify hot topics and work with members to resolve them.

We also want to identify technical priorities and new capability challenges that the NPS-FM will bring and progress them where possible as well as provide our members with information to better understand the NPS-FM and what it means for them.

What the Government's direction will look like and the timeframe for any changes is not yet clear, although the Minister has indicated he wants to move very quickly.

We will ensure that members are kept up-to-date with progress, but if you have any issues you would like to discuss please feel free to contact charlotte.cudby@waternz.org.nz or call on 04 495 0893.

Water New Zealand Board Elections

Call for nominations for election to the Board of Water New Zealand closes on Tuesday, 31 July 2018. The Board comprises six elected members and may include two co-opted members. Members are elected for three-year terms. This year, two positions are available. Sitting members Dukessa Blackburn-Huettner and Vijesh Chandra will retire by rotation.

Members contemplating standing for the Board may wish to discuss the role and responsibilities of directors with sitting members of the Board. The candidate, nominator, and seconder must all be financial members of the Association.

Annual General Meeting

The Water New Zealand 2018 Annual General Meeting will take place at 5.00pm on Wednesday, 19 September at the conference venue, Claudelands Arena, Hamilton.

To meet constitutional deadlines, any notices of motion for this meeting must be supplied to the Chief Executive by 5.00pm on Monday, 14 August 2018.

Notice of Meeting, Agenda and any Call for Nominations will be sent to financial members by Wednesday, 23 August.

Please contact Amy Aldrich, Association Secretary, Water New Zealand, if you have any queries. Phone: +64 4 495 0894, Email: amy.aldrich@waternz.org.nz

WIOG conference focuses on meeting water challenges

David Luke from Hauraki DC holds the WIOG-IXOM taste award.

The theme of 'Meeting Challenges' at this year's Water Industry Operator's Group (WIOG) annual conference was particularly relevant given the issues that the water sector has faced in the past 18-months, says WIOG chair, Nick Hewer-Hewitt.

It was the first conference following the signing of a Memorandum of Understanding between WIOG, Water New Zealand and the Trade and Industrial Waste Forum (TIWF) signalling a closer working relationship between the three organisations.

Around 240 delegates attended the annual three day get together in Palmerston North back in May.

"We've had a whole range of issues that have been hitting the headlines – from drinking water contamination, flooding, earthquakes, failed infrastructure to sewer discharges," says Nick.

"How we meet those challenges will have a big impact on the way we work in the future."

He adds that the conference provided a great opportunity for operations staff to talk about these challenges and to share new innovations and technology that will become pivotal to meeting the increasing demands of working in the water operations sector.

Also at the conference, the third Annual WIOG/Ixom National Water Taste Competition was held and, for 2018, the country's best tasting water came from Hauraki District Council's Raglan water supply.

As part of the MoU, WIOG co-hosted the Palmerston North Water New Zealand Water Waste Stabilisation Pond Good Practice Guide workshop on the last day of the conference. The workshops, which were held around the country, were aimed at ensuring operators and councils are aware of the recently published guidelines.

WIOG's next annual conference will be held in Christchurch next May.

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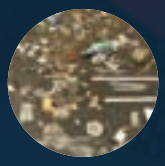

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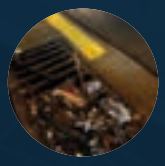
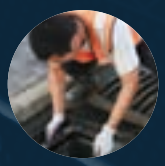


Reduce your costs

Installing a LittaTrap can reduce the risk of stormwater infrastructure blocking further downstream by acting as pre-treatment for other treatment devices.



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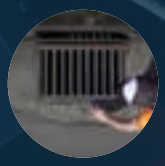

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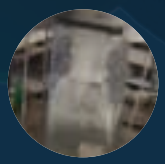

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Blanche set to create tunneling record

A new Tunnel Boring Machine (TBM) arrived at Army Bay, Whangaparaoa to help install a new outfall pipeline, as part of $31 million of upgrades to Watercare's Army Bay Wastewater Treatment Plant.

The current pipeline is nearing the end of its operational capacity and needs to be replaced with a larger pipe. The new infrastructure will ensure greater reliability and resilience of the treatment plant as the Whangaparaoa region expands. Treated wastewater discharge volumes at the plant will quadruple, from 350 litres per second to 1450 litres per second.

The state-of-the-art $6.2 million micro TBM was imported from Germany and uses a 'direct pipe' method of tunnelling, which means sections of steel pipe will be thrust into place.

The two kilometre route starts at the treatment plant and ends at the foreshore.

Watercare project manager, Dirk du Plessis, says this is a record-breaking effort: "This is the first time that this Direct Pipe method is being used in New Zealand and a two kilometre thrust will be a world record!

The TBM has been given a name, as is the tradition in the construction industry. Earlier this year, project staff from Watercare and contractor, McConnell Dowell were given a shortlist of proposed names and then voted for their preferred option.

'Blanche' was the name chosen and recognises the matriarch of the Shakespear family, after whom the nearby reserve land is named.

Letter to the editor

The March-April *Water* New Zealand published a piece commenting on a decision by the Waipa District Council to not proceed with the formation of a Shared Water Management Company (SWMC) in conjunction with Hamilton City Council.

There was a long history of reports on possibilities for gaining efficiencies among the various councils in the region.

None of these earlier proposals were accepted by the local bodies involved. It could legitimately be said the latest proposal recommending the establishment of a SWMC was a "last ditch" effort to secure change. It was rejected by Waipa (Hamilton had accepted the proposal) opting for the status quo after considering both the report and public submissions.

A key feature of democracies based on the Westminster model, such as ours, is the concept of elected representatives providing leadership at both local council and central government level.

This may not be a perfect solution, but so far no one has devised anything better. The rejection was an example of democracy in action and we should respect the decision the councillors made.

As a former secretary of the Australian Commonwealth – one Ken Henry – made clear in a speech to his staff in 2007, advice needs to be responsible as well as responsive.

Put another way, the public service is required to furnish the Government of the day with what it needs to hear and wants to hear, and what it needs to hear but may not want to hear. That is the nature of the bargain.

At the end of the day, public servants may well repeatedly advise, but the government of the day may choose to act at variance with that advice. That, too, is part of the bargain.

Regards

Robin Johnson


Andrew Campbell


Maria Mingallon

Mott MacDonald appointments

Mott MacDonald has appointed Andrew Campbell as geotechnical practice leader for Australia and New Zealand.

Based in Auckland, he will be responsible for the leadership, development and growth of the consultancy's geotechnical team across Australasia as well as project delivery.

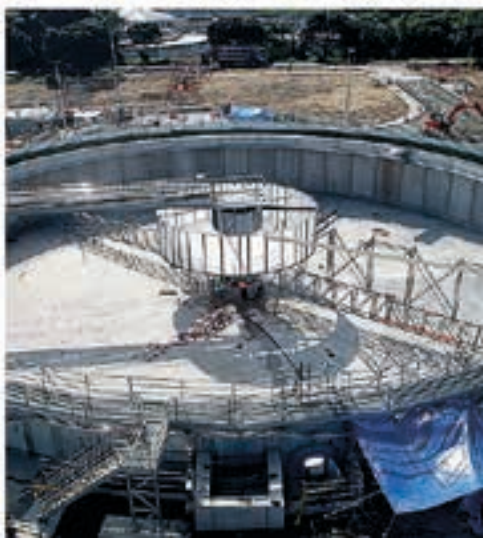
Andrew has 25 years' experience of working on a wide range of civil, mining and geotechnical projects globally, including Riyadh Metro Lines 1 and 2 in Saudi Arabia where he led on the investigation, assessment of ground conditions and geotechnical design for 67km of new metro.

Andrew was also the geotechnical lead for the Auckland rail electrification project, which involved the design and construction of over 3500 foundations for the overhead lines. He joins Mott MacDonald from AECOM, where he was most recently practice area lead for ground engineering across Australia and New Zealand.

Mott MacDonald has also appointed Maria Mingallon as technical director for its advanced computational design practice (ACD) in Australasia, responsible for growing and leading the ACD practice in this region.

A specialist in parametric design, advanced computation and digital fabrication of complex geometry structures, Maria spent over 12 years at Arup in the UK and Canada.

New BNR facility opens in Auckland



The official opening of the new Biological Nutrient Removal facility at Watercare's Mangere Wastewater Treatment Plant in Auckland, costing $141 million, takes the plant into a new era, adding treatment capacity for a further 250,000 residents, as Auckland's population grows.

Both Mangere and Rosedale wastewater treatment plants use primary (mechanical), secondary (biological) and tertiary (filtration and ultraviolet radiation) methods to treat wastewater before it's discharged into the Manukau and Waitemata Harbours.

The investment helps increase the capacity of the plant to cater for a further quarter of a million people to match Auckland's rampant growth and improves the quality of the water treated by removing nitrogen, and phosphorous.

It also represents the largest wastewater infrastructure project in Australasia at the present time.

Goff says improving water quality in Auckland is a priority for his council.

"We are spending more than $26 billion over the next 10 years investing in infrastructure, including upgrading our waste and storm water infrastructure."

The project was delivered by a joint venture between McConnell Dowell and HEB Construction.

Earthworks began in late 2013 and at its height, up to 250 contractors a day were on site. The new facility includes two new four-stage treatment reactors, two new 52-metre diameter clarifiers and associated pump stations, pipes and blower facilities.

Watercare chief executive Raveen Jaduram, pays tribute to the many Watercare staff and contractors who worked on the new facility.

"The project has gone extremely well despite some torrential rain we experienced last year, providing some testing conditions for everyone involved.

"Watercare has a $5.5 billion capital infrastructure investment forecast during the next 10 years, showing our commitment to improving water and wastewater services for the people of Auckland for many years to come."

Better management of Waste Stabilisation Ponds needed

By Nick Walmsley, Water New Zealand.

During April I spent two weeks on the road holding workshops around the country to bring folk up to date with the latest thinking around managing Waste Stabilisation Ponds (WSPs). I had suspicions that this common means of wastewater treatment was not well understood and this was indeed confirmed.

The sessions were based on the new Waste Stabilisation Pond Good Practice Guide published by Water New Zealand with locations picked close to where large numbers of these ponds are established. The sessions were widely advertised and open to all. Most of the attendees at the six workshops were operators, along with some consultants and asset managers.

Disappointingly there were few attendees from other folk who have responsibilities over these assets such as from Regional Councils and District Health Boards. There was only one far sighted councillor who attended.

In New Zealand there are nearly 200 WSPs treating municipal wastewater. It is the most common process used; both efficient and cost-effective when well managed. The Guide was written because there was little modern reference or training covering all aspects of ponds currently available.

The sessions included some lively discussions and it became clear that most of the information was new to those attending. Alarmingly, it emerged during the workshops that almost none of the 200 or so ponds in our country are being operated well enough – and this is by the operators' and asset managers' own admission. Lack of funding and lack of training were common themes throughout many parts of the country.

Most staff were qualified in other disciplines but had no specific training related to this asset and community service they were providing. It became clear that this was also the case for the senior managers, councillors and others who command the purse strings and are responsible for professional development and strategic direction of services.

Unfortunately there doesn't seem to be a national system for providing and monitoring professional development within local government and therefore nothing formal to pick up areas where skills and training are lacking.

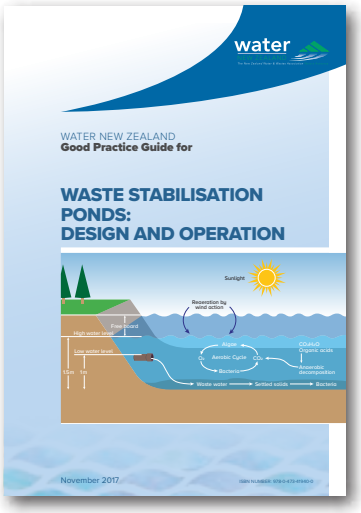
Very few operations monitor enough parameters to know how their ponds are performing. Many operations are only being funded to monitor the resource consent conditions; a legal necessity but more focused on the receiving environment than pond performance.

This is not enough to understand or control the plants and can pose a significant risk since there is insufficient warning of any problems. They will only know there is a problem after the event when things have already gone bad e.g. they have discharged a sub-standard effluent into a local waterway. Correcting after the event is always much harder and often a political embarrassment!

Pond sludge remains a massive and hidden liability. The fundamental truth is that whenever and however you treat wastewater you produce sludge which must be dealt with as part of the total wastewater management process. Focusing on effluent alone is not enough.

Treatment by ponds produces the sludge out of sight, underneath the water surface. As a consequence it tends to be ignored or forgotten and poorly managed. Too much accumulated sludge in a pond is also a common reason for poor pond performance.

Councils need to understand the increase in their sludge production as this relates to an annual increase in financial liability and business risk. The sludge needs removing every 5 or 10 years, often needing resource consents and causing temporary effluent quality deterioration. Ideally the sludge will be beneficially used on agricultural land with community acceptance.



Councils commonly account for sludge accumulation within their total plant depreciation. Unfortunately this does not provide any clear signal of when desludging needs to occur or the logistical or community issues of importance for managing the risk. Also, the Water New Zealand National Performance Review surveys demonstrate that few councils fully fund depreciation.

My view is that councils need to ensure that desludging is specifically highlighted in their 10 and 30 year plans with annual plan updates. It can be a significant business risk to them. The issue here is that by not getting adequately highlighted, senior staff, politicians and ratepayers do not know desludging is required at significant cost and often community frustration.

I would also strongly advise operators to be more proactive in alerting their organisations about the risks and gaps in their organisation's management of WSPs and to be putting forward the case for better training and funding. The need is real and those holding the purse strings don't know what they don't know.

Hopefully the Guide, and discussions through the workshops, will prompt operators, asset managers and other folk with responsibility for Waste Stabilisation Pond performance to create their own training sessions and share their knowledge and experience to the benefit of their organisation and the communities they serve. **WNZ**

- For further information contact Water New Zealand, or go to the website to download a free copy of the Waste Stabilisation Pond Guide.

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Rising to the challenge – Stormwater 2018

Alan Titchall wrapped up in his winter woollies and set off to Queenstown as a guest of the Stormwater 2018 conference.

There was a big turnout for the Stormwater conference this year (over 300), probably because it was held in Queenstown, and who doesn't want a tax-free trip to the jewel in the crown of Kiwi tourism?

To be fair, there is also a lot of interest in how the new Government is going to tackle the nation's three waters challenges this year and it was very impressive to have the Local Government Minister, Manaia Mahuta, turn up to speak at the conference dinner and sing us a sweet pre-meal song. When was the last time that has happened?

Stormwater 2018 also got a second name – the 'Roading Crossing Conference'.

Curiously, the pre-conference programme had the words 'road crossing' between the four concurrent sessions divided.

I thought this was some arcane stormwater sector speak until I got there and found the session evenly divided between two hotels either side of the main road out of Queenstown. You have no idea how much traffic pours in and out of that wee township until you try and cross Frankton Road, a perfect case for a speed bump and a pedestrian crossing please, particularly when the temperature is minus one and the rain is incessant.

Concurrent presentations are a good way of catering for specialist interest but no good for journalists who can only be in one spot at the same time. However, the few presentations I did sit through (covered in this issue) were exceptional and with a lot of queries and questions from the audience always a good sign.

If there was a theme this year is was green, landscaped urban stormwater systems, as opposed to draining run-off under ground through pipes. This is a worldwide trend along with the preservation of wetlands, once drained for land development.

The opening keynote address, from James Lenhart, was on this precise subject and an intervew with him is on page 22.

Road crossing became an art.

Lenhart, who is an engineer at US-based Content Engineered Solutions and inventor of filter systems, gave a sobering warning about the cost of these urban landscape systems and assets. They always look great when they are commissioned, he says, but without on-going maintenance they deteriorate very quickly. The life cost of a project is more important than the establishment costs, he iterates.

Another major theme was the effects of future climate change and sea level increases on current and future infrastructure.

It was difficult not to get somewhat cynical about presentations showing images of coastal storm surges as if this is a new weather phenomenon (which it isn't on an island nation sitting isolated in the middle of two vast oceans) and associating these with fractional sea level increases.

Even The Deep South, a body of scientists hosted by NIWA, with the role of the "Antarctic and Southern Ocean in determining our climate and our future environment," observes on its website (processes and observations): "Gaps in our understanding about Southern Ocean and Antarctic processes limit the reliability of global climate prediction.

"The earth's climate is so complex that individual components of the climate system, and their interactions, need to be well understood if future predictions are to be reliable."

Which begs the question – if we don't know exactly what is going on (beyond predictions based on modelling) just how do we adapt to an ocean-influenced climate that has never been static?

I didn't get to sit through Robert Bell's (NIWA programme leader: natural hazards and risks) on adapting coastal stormwater and drainage systems but had a talk with him later.

That interview will be published in the next issue of *Water New Zealand*. **WNZ**

Award evening in pinot country

Stormwater solutions provider CKL (celebrating its 30th anniversary this year) sponsored the pre-dinner drinks and conference dinner, held at the Winehouse function rooms at Gibbston (the 'Valley of Vines').

It was a cosy atmosphere with long tables and a roaring log fire, Te Radar as MC for the night and a special guest – the Minister for Local Government, Nanaia Mahuta.

Not only was it the first time any minister had turned up for the Stormwater conference, but the minister spoke from the heart and spoke the language of the industry.

"This is the time to be having big discussions in a country that can be more conscious in the way our land and people are developed," she said, while talking about the Government's new approach to water matters from a community well-being perspective. Mahuta said she was reporting to her Cabinet in October and was looking forward to the industry taking a leadership role in the discussion.

"This is big stuff and we need sector expertise and advice, so thank you for your work. She finished with singing a sweet waiata about water and love. "Love is like water," she said, "it trickles down and flows through us."

Conference chair Bronwyn Rhynd (from CKL Surveys) presented the Stormwater Professional of the Year award, acknowledging there were a lot of entries this year. This award recognises an individual within the industry who has made a significant contribution to stormwater management and the development within the wider spectrum of engineering, research or industry.

MC Te Radar.

Minister for Local Government, Nanaia Mahuta.

Winehouse function rooms.

Awards

Mike Hannah, Stormwater360.

The recipient of the inaugural Innovation Award was Mike Hannah *(Enhanced Catchpit Performance)*, chair of the Stormwater Special Interest Group and co-founder, managing director and technical engineer at Stormwater360 (he set up the company with Greg Yeoman in 1996).

Jahangir Islam AECOM.

The Stormwater Conference Paper of the Year was voted for through the new conference app and went to Jahangir Islam (AECOM), Josh Irvine (WSP Opus), Nick Brown and Nadia Nische (both Auckland Council) for their paper *Continuous Simulation Modelling to Support Healthy Waterways* (see page 26).

Bronwyn Rhynd of CKL.

Professional of the Year:Bronwyn Rhynd (CKL).

Dukessa Blackburn-Huettner, President, Water New Zealand.

Liam Foster, WSP Opus.

Mike Hannah, Stormwater360; Innovation Award winner.

Babar Mahood, Unitec; Manjit Devgun, Hamilton City Council.

Jonathan Moores, NIWA; Mark Walmsley, Waipa District Council.

Vijesh Chandra, GHD; Jenny Vince, Beca.

Campbell Burrows (sponsor of the conference dinner).

Gerald Strayton, Pattle Delamore Partners.

Gretel Silyn Roberts, Auckland Council.

Talking green **stormwater concepts**

James Lenhart, a stormwater engineer from the US, was the keynote speaker at the Stormwater conference. His subject was Operations and Maintenance of Green and Grey Infrastructure. He talks with **Alan Titchall** about his stormwater engineering experiences.

Could you explain your background thanks?

I work for Contech Engineered Solutions (www.conteches.com), a manufacturing company that provides civil works products along with engineering design services for consulting engineers.

Originally, the largest corrugated metal pipe manufacturer in the United States, Contech diversified into other products such as steel bridges, precast concrete structures, retaining walls and revetment systems and stormwater treatment technology.

I am involved in the area of stormwater equipment, and we manufacture a number of hydrodynamic separators and stormwater filtration and detention systems. We also are actively engaged in field and laboratory research.

The connection with New Zealand is through Stormwater360 who is our licensee.

What was your infrastructure presentation based on?

I'm the chair of the Urban Water Resources Research Council, which is a council underneath the Environmental Water Resources Institute, which, in turn, is a specialty institute of American Society of Civil Engineers.

We put out a lot of publications and organise different conferences that are focused on Low Impact Development (LID), Operations and Maintenance Stormwater Control Measures, and our annual World Water Congress.

We also get involved with the International Conference of Urban Drainage, which happens every three years in different cities throughout the world. We decided a couple of years ago that a good subject would be to start having a forum and a discussion around operations and maintenance for green and grey infrastructure.

In our experience, it's an issue that's growing in magnitude and our ability to fully understand and manage it and implement it is pretty limited.

So, last November we set up the first inaugural conference in Denver, Colorado (www.omswconference.org) on operation maintenance of green and grey infrastructure. I was the technical chair for that so I put together the framework for it and managed it.

My keynote at the NZ Stormwater conference in Queenstown was, basically, an overview of what was learned and discussed at that conference.

Are you still hands on with stormwater maintenance?

I have been professionally involved a lot with maintenance operations. The company that I used to own, which was acquired by Contech, developed a filtration system.

Filters will collect sediments and they're very effective at it, so you've got to maintain them. I started doing research on this subject and getting involved in maintenance operations in late 1999. I published my first paper on this subject in 2000.

These days, Contech provides operations and maintenance management for all of our systems throughout the United States, and there's literally tens of thousands of them everywhere.

How would you define green technologies?

Green Infrastructure (GI) tends to be vegetated technologies associated with infiltration to manage both water quality and reduce runoff volume. These technologies include Bio-retention systems, green roofs, permeable paving, rainwater harvesting and many variants of these. Stormwater, historically has been treated as a waste, to get off the site and discharged to treceiving waters.

Now people are saying no, let's manage it as an asset, not a liability.

A vegetated system slows the water down, it soaks it up and reduces the total annual run-off, especially for more frequent small storms. It still doesn't manage a big storm. If you get a 100-year storm, which we seem to be getting more frequent and intense with climate change, you still need to detain and convey that out.

That was a big theme at the Queenstown conference.

Green infrastructure is becoming huge in the United States and the US EPA has made green infrastructure the primary focus on managing storm water run-off.

There was a report done by the National Academy of Sciences about 10 years ago (http://dels.nas.edu/Report/Urban-Stormwater-Management-United/12465) and it basically says water quality, which is the primary focus of the Clean Water Act, is one thing – but in order to really solve the issue, in terms of stream degradation, ground water recharge and everything else, you have to manage volume as well as water quality.

So, right about that time there were a number of designs, including infiltration trenches, filter strips, ponds, and permeable pavers.

These technologies served as a foundation for developing today's applications and a focus of a lot of research and urban planning and development.

There's also site aesthetic benefits, heat island reduction, and other side benefits that make this an attractive urban watershed management approach.

For example, it is very difficult to build something in Washington DC without having a green route on it and a lot of cities are mandating it such as Chicago, Toronto, Vancouver, Washington DC.

And the grey part?

The grey part is really pipes, catch basin (gully pits), underground detention and treatment systems and other infrastructure that has been developed over the years.

James Lenhart. A filtration sysytem he developed.

For example, our company manufactures large detention systems to capture very high intensity storms, store that large volume in the pipes and bleed it out slowly so you don't wash the streams out and can reduce the size of a downstream treatment system. That's considered grey infrastructure.

There's another term called 'low impact development' and the whole idea is that if you're using LID techniques where, hypothetically, the receiving waters do not see a difference between developed and undeveloped conditions.

Your presentation came with a strong warning

Urban environmental designs are seeing us putting in tens of thousands of these systems everywhere. We see a lot of presentations on them with a lot of photos, and they look great.

But over a period of time these designs get impacted by sediments, the plants grow out of control, and trash and debris collect in them.

What we visualise and what we build is not what we will end up with if they are not maintained. That's often a reality and it's not pretty.

I think municipalities and private landowners are not prepared for long-distance maintenance of these systems, and things just seem to pile up. They are starting to realise that, for these things to operate correctly and maintain the aesthetic value, you have to maintain them. And people are really struggling with the cost and resources involved in these asset management systems.

Another big issue with both green and grey infrastructure is people design with a focus on initial build cost, not whole life cycle costing. Once municipalities understand the cost of maintenance then they can start doing whole life cycle management and costing, and put it into asset management systems.

With older systems, a lot of municipalities don't know where the original designs and plans are – what it's supposed to look like, how it was built, how it was designed.

Smaller cities are really struggling with this, while the bigger cities that have a lot of capital are making a lot of progress – New York and a few others.

What about the larger natural water assets?

In the US we have what we call a Total Maximum Daily Load, (TMDL) programme, which is part of the Clean Water Act. Basically certain receiving waters are studied and then a decision is made, usually a court decision, in terms of what is the maximum daily load that can go into these waterways.

The magnitude involved can be staggering. When it comes to Chesapeake Bay (a large 166,534 square kilometre estuary in the states of Maryland and Virginia in the Mid-Atlantic region) I think eight states contribute to this water body.

How do you finance and fund new and retrofitted stormwater utilities to control run-off into this area? Estimates to achieve TMDL compliance are between US$30-35 billion.

Is this being driven at a federal level?

Yes. The federal government issues permits to the states and then the states go to the individual municipalities and give them permits.

Federal and state consenting is overarching, while the Clean Water Act in the US doesn't talk specifically about what you have to do but rather what needs to be achieved. In the permitting process the EPA and associated permitees work through a process to set water quality goals. Many municipalities use runoff reduction to achieve these goals.

Some states set their own standards, others don't. The state of New Jersey for example says, you have to remove 80 percent of the total suspended solids (TSS) out of your stormwater while its Chesapeake Bay TMDL focuses on phosphorous load into the bay.

And if you look at what it takes to get phosphorous out of the water, it's not easy. The easiest way to do it is not have the water go there in the first place, so this is where a lot of the low impact development retrofitting is going on.

In terms of stormwater, how does the US compare with the rest of the world?

It's a good question. I've been to a lot of different places, Australia, New Zealand, China, US, Europe, and everybody is doing something. But while the approaches are sometimes different, most of the time the objectives are the same.

One of the projects I talked about in Queenstown is where one of our licensees in Italy is providing all of the stormwater treatment for an 82 kilometre, six lane toll road that is part of a massive transportation master plan in the Veneto region of Italy.

This area is a highly industrialised, densely populated region, while having some of the most sensitive cultural and water resources of Italy.

So they are putting a web-enabled network of filtration systems and spill containment facilities with maintenance management. Right now this is probably the world's largest real time control project and it's happening in Italy, not in the US.

China is spending about US$12 billion right now on green stormwater pilot projects, and they do it in a big way involving 12 cities.

This includes anything from retrofitting residential, and business areas with permeable pavement with floating wetlands with filtration systems and screening systems – all the way to complete restoration of river systems. The scale of these is just unbelievable scale.

Is there a free exchange of these new stormwater projects concepts?

For the most part there is, because a lot of the innovation is not just involving manufactured products with patents on them.

China, for example, puts on a lot of conferences and lot of American speakers and European speakers are invited. I have been to China a couple of times and the scale of their stormwater projects are mindboggling. The cities are just enormous and tackling issues of weather quality, flooding and runoff volume are very challenging. **WNZ**

STORMWATER 2018 CONFERENCE TRADE

1. Allan Leahy (MWH and recipient of the 2017 Stormwater Group Professional of the Year award) and Kirtina Ismail (Hynds).
2. Scott Judd (Cirtex).
3. Anton Carr (Stormwater360).
4. Dan Westlake, Eurofins.
5. Chris Thorpe and Matthew Bone (both from Humes).

4

5

STORMWATER 2018
PAPER OF THE YEAR

Jahangir Islam (AECOM), **Josh Irvine** (WSP Opus), **Nick Brown** and **Nadia Nitsche** (both from Auckland Council) won the Paper of the Year award for their presentation *Continuous Simulation Modelling to Support Healthy Waterways* at the recent Stormwater 2018 conference in Queenstown.

INTRODUCTION

The National Policy Statement for Freshwater Management (NPSFM) directs regional councils and communities to set objectives and limits to better manage freshwater quality. Sediment is one of the key 'matters' identified in the NPSFM, for regional councils to take into account for a healthy freshwater body and is included in both compulsory values of ecosystem and human health (MfE, 2017).

Auckland is currently experiencing unprecedented urban development, with more than half of New Zealand's population growth in the next 30 years predicted to occur in the region. Many streams in the region are currently assessed as degraded, experiencing significant erosion from the hydrological effects of existing development.

Without further intervention, future growth is likely to significantly exacerbate the issue. Conventional development increases runoff volumes and the duration of elevated peak flows which consequently degrade the morphological and ecological functions of streams. The observed increase in stream erosion in the region is a major concern for Auckland Council, iwi and the general public.

Frequent storm events contribute to the majority of the stream erosive effects compared to larger, rare events. Research indicates that most of the sediment in streams is from streambank erosion processes rather than from slips and exposed soils in the catchment.

Developing appropriate solutions to manage streambank erosion requires a good understanding of the associated flows for frequent storm events. The current event-based modelling practices adopted in the Auckland region (e.g. TP108) are not suitable for predicting stream flows for frequent storm events.

This is because variations in the long-term pattern of rainfall intensity and duration, antecedent soil and storage conditions, and inter-arrival times between storms can have a significant impact on the frequency and duration of flows. Long-term continuous simulation modelling is best suited to represent these processes and to predict low-magnitude stream flows.

In the Auckland region, of the 233 catchments only 18 percent have flow gauge information (the average catchment area is 2000ha). Due to the limited number of stream flow gauges, continuous simulation modelling is required to simulate the hydrological processes.

The purpose of this study is to develop a continuous hydrological modelling methodology using EPA-SWMM software, to predict stream flows in un-gauged catchments.

By analysing gauged catchments, a suitable set of continuous hydrological modelling parameters can be established. Where ungauged catchments have similar characteristics, these parameters can be adopted, enabling a prediction of stream flows, and in turn an assessment of the stability of streambanks, considering critical shear stresses, can be undertaken.

This is critical to achieving healthy waterways – not only to mitigate the impacts of further development but to begin a process of restoring stream health across the region.

This study helps to enable the assessment of erosion mitigation interventions and to demonstrate meeting sediment targets under the NPSFM.

ABSTRACT

Frequent storm events contribute to the majority of stream erosive effects compared to larger, rare events. Developing appropriate solutions to manage erosion requires a good understanding of the associated flows for frequent storm events. Long-term continuous simulation modelling is suited to represent the complex hydrological processes and to predict low-magnitude stream flows.

Continuous simulation hydrological models for five gauged catchments in the Auckland region were developed using EPA-SWMM modelling software. Three infiltration models were used – Horton's method, Green-Ampt method and the Curve Number (SCS) method.

Each of the models was calibrated against the stream flow gauge in the catchment. Calibration of the hydrological models considered methods other than just matching peak flows and the receding limb of individual events.

This included calculation of the Nash-Sutcliffe model efficiency coefficient, matching of the peak flow frequency and flow duration curves from the gauge and the model. This ensures better overall flow replication and thus allows for better prediction of frequent events.

Calibration resulted in a good match for >99.5 percent of the stream flows. Four out of the five catchments calibrated provided at least a satisfactory match, based on the Nash-Sutcliffe results, with the Whau catchment providing a very good calibration and the Hoteo catchment providing a good calibration.

The analysis undertaken across the five gauged catchments enables

Josh Irvine, from WSP Opus, and Jahangir Islam, from AECOM, with Minister of Local Government Nanaia Mahuta.

a suitable set of continuous hydrological modelling parameters to be established. These parameters could be adopted for ungauged catchments across the Auckland region and used to better understand stream erosion processes in lieu of observed data.

The understanding of the stream flows can then be used to calculate stream flow velocities and shear stress acting on the stream bank to predict which streams may erode and where, and to estimate the quantity of streambank erosion and sediment in the receiving environment.

The resultant models can also be used to assess the effects of future development and the benefits of potential erosion mitigation interventions. This is critical in protecting and restoring stream health and attaining healthy waterways.

CONCLUSIONS

The following conclusions can be made from this study:

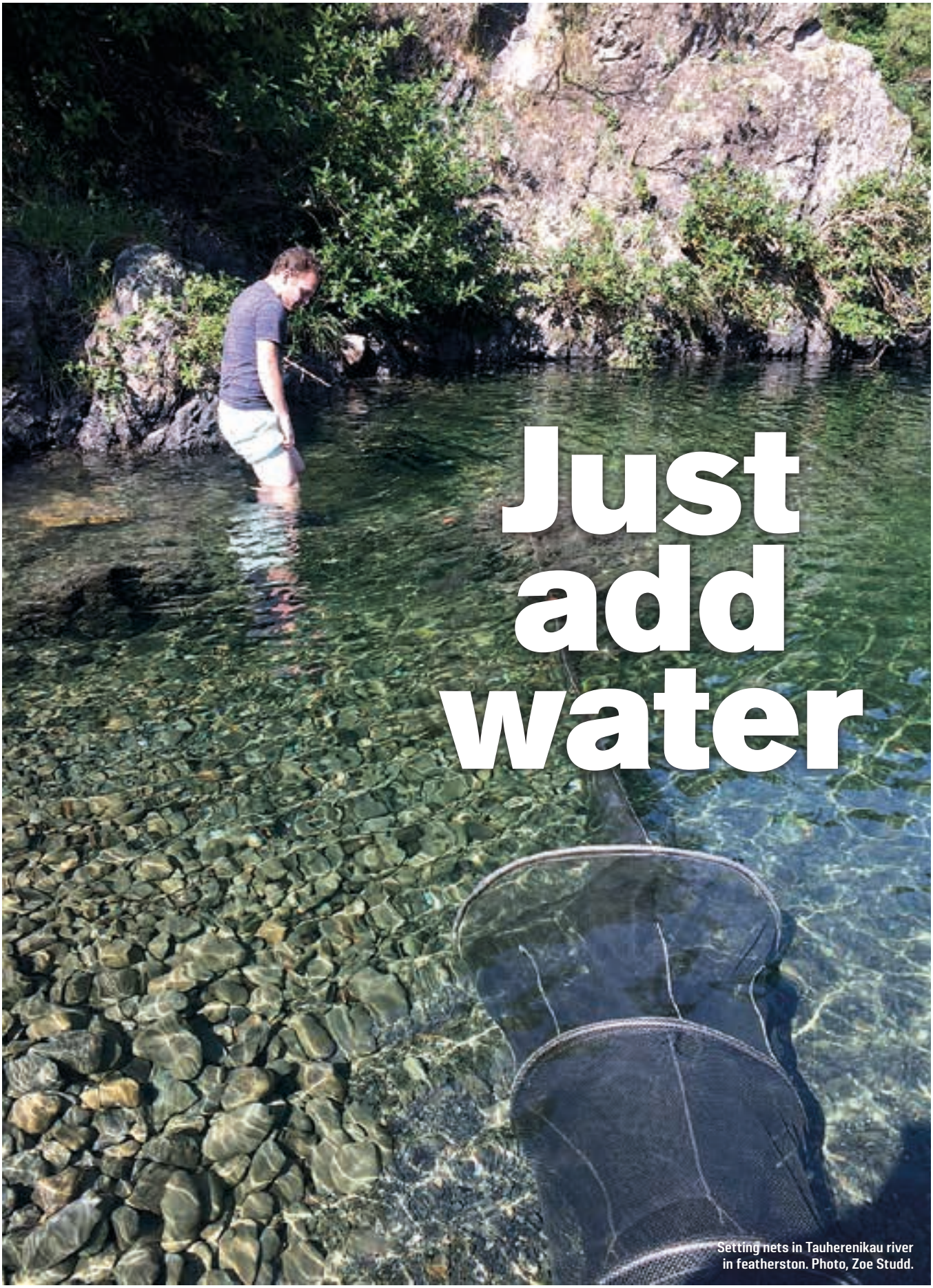
- Continuous simulation modelling is suited to predict frequent stream flows, as it can represent variations in the long-term pattern of rainfall intensity and duration, antecedent soil and storage conditions, and inter-arrival times between storms that can have a significant impact on the frequency, magnitude and duration of flows.
- The Curve Number (SCS) method implemented in EPA-SWMM is only an approximation of the method and does not replicate the Curve Number runoff peak flows and volumes. The error is greatest for lower curve numbers in pervious areas. Another error was found with the EPA-SWMM software, when the depression storage parameter is used along with the Curve Number infiltration method for continuous simulation. Infiltration losses cease after approximately a year (depending on parameters). This has been acknowledged by EPA-SWMM software developers. Considering these reasons, the Curve Number method implemented in EPA-SWMM software should not be currently used for single event or continuous simulation modelling.
- The spatial variability of rainfall is a key issue when matching flows. The Whau and Hoteo catchments provided the best match and were the catchments with rainfall gauges located in the catchment. The unsatisfactory match for the Westhoe catchment is likely due to the distance to the rainfall gauge. The Westhoe rainfall gauge was located three kilometres away from the catchment.
- Calibration was undertaken and assessed by comparing observed and predicted hydrographs, the calculated Nash-Sutcliffe model efficiency, flow duration curves and peak flow frequency curves. It was found that no one comparison method provides certainty over calibration.
- Calibration resulted in a good match for 99.9 percent of all stream flows for the Whau and Hoteo catchments and 99.5 percent for the Lucas and Chartwell catchments.
- Peak flow frequency results show that <one year ARI flow events are well matched and >one year ARI flow events provide a reasonable match for the Whau and Hoteo catchments.
- From the Nash-Sutcliffe results, four out of the five catchments calibrated provided at least a satisfactory match, with the Whau catchment providing a very good calibration and the Hoteo providing a good calibration.
- Of the parameters used in calibration, the catchment width, groundwater surface elevation and groundwater A1 coefficient were the most sensitive. To reduce uncertainty with these parameters, it is important to understand the catchment width parameter and catchment specific groundwater parameters.
- An accurate representation of the groundwater in the catchment is key in representing frequent stream flows. A good understanding of the catchment's specific groundwater conditions is important to achieve this.
- The Horton and Green Ampt infiltration methods provided similar results, in terms of the Nash-Sutcliffe result, hydrographs, and the flow duration and peak flow frequency curves.

This study is leading to the development of a long-term continuous simulation modelling methodology in the Auckland region.

The methodology and parameters will be further refined through experimentation with other catchments using the knowledge and issues gained in this study, to reduce uncertainty in model results and thereby gain a level of confidence in establishing the hydrological modelling parameter values.

These parameter values can be adopted for ungauged catchments across the Auckland region and used to predict whether a stream will erode and can be utilised in contaminant loading assessments. **WNZ**

Just add water



Setting nets in Tauherenikau river in featherston. Photo, Zoe Studd.

Mountains to Sea Wellington is a charitable trust established to deliver freshwater and marine education programmes, and support envrionmental restoration and community science. BY **MARY SEARLE BELL**.

Mountains to Sea Wellington connects communities with their local water environments. As CEO Zoe Studd told *Water New Zealand*, "We're here to help them build an understanding through science and exploration, and encourage them to restore and care for the environment."

The Wellington trust went independent a year ago, although the group has been in action in Wellington for the past 10 years. They work as part of a larger national trust – The Mountains to Sea Conservation Trust, which operates in eight other regions around the country.

The national body has developed two main education programmes: one for salt water, another for fresh.

'Experiencing Marine Reserves' focuses on everything that lives in and around the ocean, and covers things such as the impact of plastics in the sea and the benefits of marine reserves. It has children out snorkelling with the coordinators, getting a real hands-on look at their local ocean environment and learning about the importance of biodiversity, ecology and protection of the marine environment.

The freshwater education programme goes by the name of 'The Whitebait Connection'. Zoe says the name was chosen because most whitebait species use the catchment during their lifecycles – from the marine environment where they spawn and far up into the upper reaches of the streams.

"The programme is not just about whitebait, but they're an iconic fish here in New Zealand. The kids are intrigued, but they don't know much about them – they don't realise we have five different species here, or that they grow as large as they do.

"Their lifecycle is fascinating. And to survive they need a good habitat, good water quality and a connection to the ocean," says Zoe.

"Our students and communities learn about freshwater catchments, human impacts, biodiversity and how to conduct science-based stream assessments. After exploring their local area, they can put their new-found knowledge into action by getting involved in restoration activities of their choice. This could range from litter clearing, to pest trapping, to riparian planting, to constructing fish ladders and more."

The Wellington Trust also runs a programme in the city and Porirua called 'Healthy Harbours', which explores the link between land and sea – in particular, the impact of the land on the marine environment. Combining elements of both the marine and freshwater programmes, Healthy Harbours provides a more in-depth investigation into where the two meet – harbours and estuaries.

The team at Mountains to Sea Wellington is comprised of a group of passionate scientists, who are eager to take students and community members into their local water bodies to learn what's going on.

"In the colder months we focus mostly on our freshwater programmes as no one wants to go snorkelling with us in winter," laughs Zoe. "And we tend to do more riparian and kaitiaki work then too – it's an ideal time for planting.

"Although the kids are great – they don't seem to mind the cold and the mud!"

The programme is adapted to the wants of the school or group that the team is working with.

Students painting inanga spawning site at Kenepuru Stream, Porirua Photo Te Kawa Robb.


Outdoor microscopes looking at Macro-invertebrates.


Eels and Inanga and students from Te Kura Kaupapa Maori o Whakatupuranga Rua Mano.

"We ask them what they want to achieve," says Zoe. "Do they want to improve the water quality, or increase biodiversity, and so on. Sometimes they don't know, and rebuilding a relationship with their stream is the first step.

"We go with them to their local stream and look at the habitat, the biodiversity, and monitor the water quality as well. We get a snapshot of the health of the stream. We then compare this to another stream to assess what their local place is really like.

"We then take a closer look: Are there any fish? Why not? Is it filling up with sediment? How could we improve that?

"One school discovered a barrier across their stream that was preventing fish from moving up and downstream, so the children built a fish passage to facilitate this.

"The aim is to find the local issues."

Zoe says a lot of the local streams are degraded and children are warned to stay away – they are told to 'keep out of the water or you might get sick'. Yet these are the same bodies of water their parents and grandparents swam and fished in.

"We had a perfect example of this recently, where a grandmother and grandson's experience of the same stream was at extreme ends of the scale. She told stories of swimming and eeling and playing all day in the water, yet her grandson, just two generations later, knows the same stream as an unsavoury place with sewage overflows and the swimming holes filled with sediment.

"If a stream is seen as somewhere that makes you sick then the place is valued less and our connection to it is diminished," says Zoe. "However, there is still life there. There is still value. And the environment can be improved – if we care enough to take steps towards it."

She tells an inspirational story about a group of young students and their newfound passion for a stream that flows through a grimy motorway underpass in Porirua.

"It's a heavily impacted part of the stream in a pretty unappealing underpass. It has lots of issues, including sewage leaks and stormwater, but there's still lots happening in there. The underpass happens to be the exact same spot that's ideal for inanga (whitebait) spawning, as they need to lay their eggs in the grasses at the salt-water wedge (the zone where salt water and freshwater mix on king high tides).

"We took the kids down to the water to explore. On the way a roading contractor stopped us, saying, "You're not taking the kids in there?". But we did.

"We set fish traps and the kids were amazed at the results. Literally hundreds of inanga filled with eggs and ready to spawn. Who would expect anything to live in that unpleasant environment? The kids loved seeing that and releasing the fish back into the stream, and gained a whole new understanding about how important that habitat is.

"They have since developed a bond with the underpass, painting a fantastic mural of the fish they saw to brighten the area, and they have plans to plant under there – grasses that whitebait prefer to spawn in – and to clean up the rubbish and debris.

"It's been an excellent outcome," says Zoe. "It's easy to value and work in a pretty stream, but not everyone has this on their back door. Now this part of a stream is also valued by the children and will continue to be cared for.

"They can't do this alone and so we work in partnership with lots of other great organisations that also help the students develop their projects."

One such partner is Stormwater360, which develops and manages efficient and innovative solutions to deal with stormwater runoff and reduce its impact on the environment.

"One of our groups of students noticed a huge amount of rubbish was washing into the sea. Stormwater360 provided LittaTraps, which catch litter and other gross pollutants before they can reach the ocean. The children emptied them weekly, noted their findings and then presented them to council," says Zoe. "These traps are now being used right across Wellington and a large number of schools are using them for education and taking action.

"Education in the freshwater space is critical," she says. "New Zealanders are very concerned.

"At Mountains to Sea Wellington, we help people, young people particularly, take action – helping them get programmes underway to monitor their local waterways and collect data, and then get their concerns out into the wider community, in front of councils and advocating for the waterways they want – so their voices can be heard for a better future." **WNZ**

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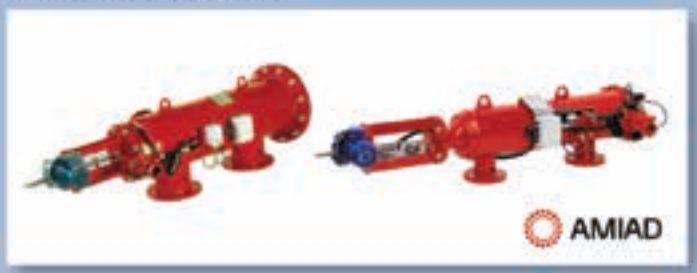

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WATER – THE DISCUSSION HEATS UP

A two-day Water Summit 2018 in Wellington was attended by local government delegates, industry experts and central government officials, who will be implementing future regulatory water reform.

As LGNZ president Dave Cull pointed out in his opening address, a summit on delivering future three waters solutions couldn't be more timely. We now have the results of the second Havelock North Drinking Water Inquiry; the Three Waters Review, led by the Department of Internal Affairs; and government readying to bring in new standards and major reform across the sector.

"Things simply have to change," he iterated, and issues of fresh water quality, funding, financing are all connected.

"Change is on the way and we ask it be done collaboratively."

The summit was hosted by LGNZ in conjunction with Water New Zealand and IPWEA. Two international speakers were brought here by Water New Zealand: Marcus Rink, the UK's chief inspector for water supplies with the Department of Environment, Food and Rural Affairs – Water Regulation; and Mike Brewster, chief executive of TasWater (Tasmania, Australia) – Tasmanian water model. Both provided valuable insights into overseas water regulatory models.

Other summit speakers were Nanaia Mahuta, Minister of Local Government; Lyn Stevens, chair of the Havelock North Drinking Water Inquiry; and Jim Graham, Water New Zealand Principal Advisor, Water Quality, and who led a very lively discussion on why treatment and chlorination is a very good idea, even when you think your water quality and testing is up to scratch.

The minister plays her cards close

Minister Nanaia Mahuta didn't give the government's water intentions away, other than to concur that it, "is a conversation we need to have together", and neither central nor local government can achieve results alone.

The week before the summit, the minister had attended the Stormwater Conference dinner in Queenstown and made a deep impression of her dedication to her role and eagerness to work co-operatively with the sector.

1. Raveen Jaduram (Watercare).
2. John Pfahlert (Water New Zealand) & Lyn Stevens (chair of the Havelock North Drinking Water Inquiry).
3. Dave Cull (LGNZ) & John Mackie (Christchurch City Council).
4. Melissa Parlane (Far North District Council) with Erica Mangin (Local Government Commission).

In Wellington the minister repeated encouraging notes about government and industry conversations as she leads up to reporting to Cabinet in October.

Meantime, the second stage of the Government's Havelock North Drinking Water Inquiry (which came out on December 6, 2017) made 51 recommendations on improving public drinking supply. One of these is for government to consider creating a new aggregated and dedicated water supplier.

Jim Graham agreed with the need for aggregation, but stresses there's a long way to go before any recommendations become policy, and there has to be a public submission process.

There are different models of ownership that could be considered from ownership of assets transferring to the newly-created supplier, he says, such as councils retaining ownership of their assets and leasing them to the supplier.

The minister didn't comment on this issue, but a response from the government on all 51 recommendations is expected by about August.

The Minister has publicly warmed to the idea of increased aggregation of regional water services through an unspecified number of water providers that would be publicly-owned (privatisation under her government is off the table), or even a small number of cross-regional suppliers, with the infrastructure and operational costs, presumably, spread over regions both urban and rural.

The minister referred to this model as a "very real prospect", and common overseas. Shortly after the summit, Nanaia Mahuta visited Ireland and the UK to get a first-hand look at the experience of water reforms and aggregation in those countries.

The Havelock North wakeup

The campylobacter contamination of two of Havelock North's water bores was a 'Pike River Mine' like wakeup call exposing the vulnerability of untreated bore water supplies.

Lyn Stevens, chair of the Havelock North Drinking Water Inquiry, painted a sobering picture of the continued risk of aquifer contamination throughout the country through the likes of landfill seepage and severe weather events.

He also noted that Havelock North was not an isolated incident, with around 35 other waterborne outbreaks recorded here over the past 45 years.

Our compliance levels are well below international standards, especially among small suppliers, he added.

It's hard to believe, but the Havelock North water supply system at the time of the contamination was actually compliant with Kiwi regulations and the current Health Act 1956.

Scale of the cost of change

Malcolm Alexander, LGNZ chief executive, spoke of the size of the funding pressure looming over three waters' infrastructure made up of 569 council-owned systems and another 225 operated by communities.

Figures provided place the new drinking water capital cost alone at between $305 and $567 million, and operating costs at between $11 million and $21 million. Work has been commissioned on the costs of new wastewater and stormwater systems and is due out soon.

There's a range of funding options, mostly already in use, that include targeted rates at local level, regional council rates, fixed and variable user charges and central government tax-payer contributions.

Malcolm took the opportunity at the summit to push LGNZ's recently published Water 2050 discussion paper and supplementary 'cost and funding' analysis, which builds on work it started five years ago.

The Water 2050 paper notes there is no single optimal funding method and multiple options are often used.

"The challenge is to determine which combination of options works best across different council areas, different infrastructure types, and different customer types," it says.

As for any new national regulatory standards that are likely to saddle councils with more costs – they should be "quantified and fair allocation based on local and national outcomes determined".

Water New Zealand says new regulatory standards need to be underpinned by the principle that all publicly supplied water is safe to drink. Chief executive John Pfahlert says it is concerning that almost two years after the Havelock North contamination event, many small community suppliers continue to fail to deliver demonstrably safe drinking water.

"There is a need for the establishment of an independent drinking water regulator who is prepared to enforce the drinking water standards.

"It is also clear that scale matters and that large suppliers such as Auckland's Watercare, Wellington Water, and Dunedin are able to meet all the compliance standards while in many small communities, compliance levels can drop to as low as 30 percent," he says.

"Provision of safe drinking water supplies is dependent on a knowledgeable, well-resourced regulator that is respected by the drinking water industry."

A new regulatory body

The idea of a new independent regulator came out of the second Havelock North Drinking Water Inquiry.

The Department of Internal Affairs' three waters review picked it up and recommends the 'urgent' setup of such a new water regulator that is independent from the Ministry of Health and district health boards. It also recommends the compulsory treatment of all public water supplies, including secure bore water supplies.

The sector has accepted that a new water regulator is on the cards and it's just a matter of what shape it will take.

John Pfahlert says the Havelock North Inquiry recommendation has raised the issue – whether it makes sense to establish a drinking water regulator alone, or whether regulation should be extended to cover wastewater and stormwater as well.

"There seems to be an emerging view that at least wastewater should be included in the ambit of any new regulator.

5. Water New Zealand Principal Advisor Water Quality, Jim Graham.
6. Donnick Mugutso (Kaipara District Counci) with Bede Carran (Timaru District Council).
7. Marcus Rink (Water Supplies UK).
8. David Caygill (Environment Canterbury) & Will Murray (Ministry for the Environment).

"There are, however, a wide variety of views on stormwater, not least of which is that there are no accepted national standards against which to regulate stormwater quality discharges," he says.

"In our view it is critical that the regulator is also independent and staffed with people with the appropriate technical expertise to oversee the performance of the sector. They need to be people who will show leadership."

As Malcolm Alexander pointed out during his presentation at the summit, we already have successful regulatory models in this country.

The gas market regulator is one such model, he says, and there are also the telecommunications and the electricity regulators that have been in operation for some time.

There are also many regulatory water models used overseas, but it's a matter of finding the right water model and context for this country, says Malcolm.

Marcus Rink, the chief inspector for water in UK, and a guest speaker at the summit, provided a big-picture of various models used in Europe (which operate with varying compliancy success).

England and Wales have a single authority (with privately-owned water suppliers) that was set up in 1989 and has achieved a very high standard of compliance. Scotland also has a single authority (but publicly owned) and with just one water delivery service.

The Netherlands has consolidated its once-numerous suppliers to 10 regional companies under a national and independent regulator and now boasts 100 percent when it comes to compliance standards (the best in Europe).

Marcus also told us that when it comes to policing water standards and regulations in the UK, he is armed with a large staff contingent and powers to seize equipment, test and prosecute. Although he talked of 99.9 percent compliancy of water standards in the UK, the size of fines he mentioned handed out for non-compliance were eye-watering.

On the subject of modeling on a local authority level Colin Crampton, CE of Wellington Water, and Raveen Jaduram, CE of Watercare in Auckland, presented two different views.

Wellington Water is answerable to five councils with a member from each on its board.

Watercare (drinking and wastewater) is an independent council controlled organisation and, asset-wise, is the second largest company in the country next to Fonterra.

Wellington (typical of most councils) charges its water services through rates; Watercare through metering (although Auckland's stormwater is rate-funded).

Colin favours keeping the three waters departments in one room. He says interrelated three waters works better than 'two-waters' from a catchment level in terms of long-term investment. Plus, for small and medium size councils it is better not to separate the staff skills, he says.

Community engagement

Guest speaker Mike Brewster, chief of TasWater in Tasmania, had a very clear message. Don't try and implement new standards and regulations without buy-in from the customer – co-operation is the best, most cost effective, method of compliance.

> **"There is a need for the establishment of an independent drinking water regulator who is prepared to enforce the drinking water standards."**
>
> John Pfahlert

Reform came to the Aussie island state after a Federal Government water audit in 2005 where it ranked lowest in complying with the country's regulatory water framework. The state, at the time, had 32 bodies managing water and 23 areas with permanent 'boil tap water' notices.

As a council-owned corporation, TasWater was set up in 2013 as a single three waters body and some A$1 billion has been invested in the state's water industry since then.

Unfortunately, says Mike, they forgot to "sell the message to the public who generally disagreed with the reasons and value behind the reforms".

"I can't stress this enough", he warned. "The costs of this mistake have plagued us for years, after new regulations were brought in. Make sure the customer is on the journey with you."

Nor was there sufficient alignment between councils and the state government, he adds. Next year, the state is taking a 10 percent interest in TasWater.

Another message from Mike was to visit other countries and look at their models.

"I took a five-week trip to Europe to check out water systems. That proved very valuable. While there is no perfect model, and only one that suits you, take the best from others and avoid their mistakes."

The grey areas

Areas that were raised briefly at the summit, but not discussed in detail, included those residents who, through no choice of their own, have to rely on septic tanks and accessing their own drinking water supplies.

At the moment this area of three waters, in terms of quality, comes under council control.

Also noted in Water 2050, but not discussed at the summit, is the Treaty of Waitangi Act 1975 (and its 'contentious' 1985 amendment) and Treaty Settlement Acts.

They contain many elements regarding the likes of land use, ownership and management for specific areas and waterways, and resource management that affect the way local authorities are expected to conduct their services, says the discussion paper.

As many councils and regulatory bodies have already experienced, the Treaty of Waitangi Act involves 'principles', 'spirit', 'interpretation' and obligatory consultation that often involve unexpected cost.

And such acts remain one of many indistinct areas in terms of improving water quality in this country, along with funding, standards and climate adaption, on which an overall regulator could provide clarity, guidance and instruction.

That's the hope. **WNZ**

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Of purity and politics

Mike Bourke has spent his career working in water for Christchurch. He talked to **MARY SEARLE BELL** of his career highlights and the great chlorination debate.

Mike Bourke is not quite sure where the past 40 years have gone. It seems just a short while ago he was an engineering student at Canterbury University, yet here he is, talking about easing back on his hours as retirement looms.

Back in the 1970s, Mike was taking a paper in Public Health Engineering, and was most impressed by the lecturer... his psychedelic trousers at least: "They were very lurid. He told us he bought them because they were cheap, and I thought, that's a damn good reason to buy a pair of pants!"

What the lecturer had to say about sanitation also sparked Mike's interest.

"People often forget that looking after water and wastewater is caring for public health until something like Havelock North happens. But that's what we do – public health."

After graduating in 1977, Mike took a job at the drainage board in Christchurch. "It was all poos, wees and stormwater," he says. However, the various local authorities merged in 1989 and as a result, Mike became involved with water supply as well. Over the following years, various restructures within the organisation meant he got a taste of all parts of the industry and worked on a wide range of projects.

One of his career highlights was the work he and his team did tackling the odour problem at the treatment plant.

"It wasn't a good space, especially for those that lived nearby," he says. "We implemented a system to capture the foul air and treat it. Within a couple of years the problem was virtually eliminated. I'm very proud of the work we did there."

He is also proud of the council's move to reuse bio solids in the environment, rather than sending them to landfill.

"The council used it on low quality council-owned farmland to improve the fertility of the sandy soil, in forestry plantations, and as part of the rehabilitation of Stockton Mine. It has a yuck factor that puts a lot of people off the process but it's a sound idea."

Another career highlight has to be the various international conferences Mike was asked to attend, where he presented on the council's biogas fuel production and use in its fleet.

"We use anaerobic digestion to produce methane, which is used as an energy source and was as a biofuel [trialled] in around 80 vehicles. This was in the mid 1980s to 1990s, when the council's trucks were [mostly] fuelled by petrol. However, as the fleet aged, they were replaced by diesel-powered trucks and the economic advantage of using biogas fuel faded.

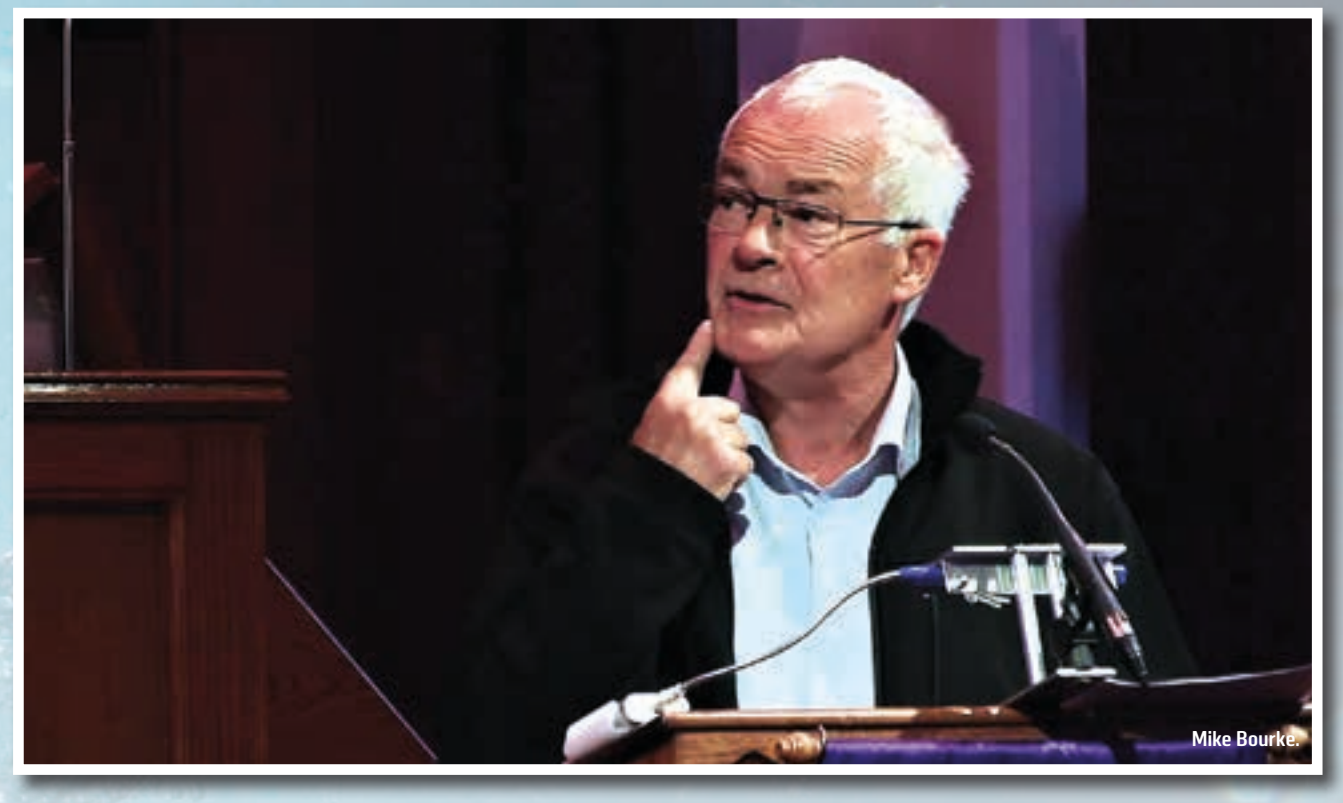
"There is still potential for the future," says Mike. "But at the time, it got me to a number of conferences around the world, which was great."

He acknowledges that working in the public sector has its frustrations and "one must have one's own private brick wall to bash one's head against," but credits his collegial relationship with his fellow staff members with his longevity with the council.

"When I do go it's the people I will miss. I have looked at other jobs over the years but the people here are fantastic. They are all committed to the customer, and to providing the best service.

Mike started his career in design, moved to supervising construction, then supervised operations for water supply and wastewater for about 30 years. He was making plans to ease out of operations and into planning when the earthquakes struck, and "buggered it for a while".

He did manage to make the move once the crisis had


Mike Bourke.

passed, and is now planning for water and wastewater; something he describes as "a lot of good fun".

"Stress is not good for the health," he says of his operations job, which had him managing a staff of up to 50. "And it's good to get to see the house in daylight at least once a day."

Christchurch enjoys a fantastic water supply, which historically has had no treatment whatsoever, says Mike.

"We do an awful lot of testing as a consequence. We have found the occasional bug but not in the source of supply – it's entered elsewhere in the system.

"Our recharge catchment area doesn't have a lot of high intensity agriculture either, which lowers our risk. In fact, our biggest risk is probably a broken sewer and wastewater finding its way into a well," he says. "The earthquakes did cause these problems, and we promptly started chlorinating the supply where the damage occurred."

"Any problems we experience are usually at the reservoir – bird poo on the roof, for example.

"These days, as soon as a bug is detected we start chlorination until either the source of the bug is found, and remedied, or we've had at least three days of clear results from our testing."

Mike says that sometimes they aren't able to find the source of contamination, which is frustrating, and the upshot is to simply up the testing.

"We take around 5000 samples a year, which are processed in our IANZ accredited lab."

The topic of chlorination is a testy one in Christchurch. The residents are proud of their pure water supply and are not in favour of chlorination, however, Mike says it is possible that it will become mandatory in the future.

"The residents will hate us for it, but from a water supplier perspective it's a good thing," he says.

"If you can't be absolutely certain, then it's not worth the risk."

Following the health emergency in Havelock North, Christchurch has been assessing the security of its supply and improving its wellhead security. Chlorination of the supply has recently been resumed as a safety measure in the interim.

"It's a difficult one for Christchurch residents," says Mike. "But there are work arounds – you can buy a filter to remove the chlorine at the tap, or simply put a jug of water in the fridge – you won't taste or smell it after it has stood for a period.

"If the public understood the risk and had to stand up to the consequences of any outbreak, they would quickly change their tune.

"Chlorine is good stuff in the right dose; and if you can smell it a bit then you know the water is safe." **WNZ**

Solving our LAKE SNOT MYSTERY

Lake snot, sometimes called slime or snow, is the bane of recreational lake users and scientists alike. **Denise McNabb** updates recent research on this waterways menance.

Manaaki Whenua/Landcare Research, NIWA, three universities, Ngai Tahu and Zebra-Tech have joined forces to activate a 'toolbox' to uncover why lake snot proliferates in some of our lakes and not others. The project, on the back of a $1 million study grant from the Ministry of Business, Innovation and Employment, uses laser technology, sediment traps and probes to collect lake snow samples for analysis by professional scientists and students.

Students are involved from Otago, Waikato and Victoria Universities. A Victoria student, Cara Lutien is doing a PhD analysis of the polysaccharides that makes up the slime.

The results will eventually form the basis of a chemical assay of *Lindavia intermedia*, the algae responsible for producing the sticky slime.

The goal, says Lincoln's Landcare Research phycologist, Dr Novis, is to enable the concurrent measurement of cell numbers, slime production and environmental variables, leading to experimental testing of possible drivers of slime production.

Lake snow is found in both North and South Island lakes, but it is prolific in Lakes Wanaka and Hawea in Central Otago and Lake Coleridge in Canterbury. It also comes and goes.

The focus over the next two to three years will be ensuring different collection methods work before they are deployed together in field trials, Dr Novis, said.

Mystery surrounds the slime production

"It is not really the cell proliferation but the production of slime and the circumstances under which the slime is produced that is the issue," Dr Novis says.

"The polysaccharide (a sugar) is the slimy stuff causing the problem.

"The slime originates as tiny threads that intertwine; these threads are suggestive of the type of molecules involved."

Chemical analysis

Students like Cara will work with professional scientists, including those who specialise in polysaccharide chemistry at Victoria University's Lower Hutt-based Ferrier Research Institute. They're also in partnership with Dr Novis and Otago University zoologist and freshwater scientist, Dr Marc Schallenberg who has pioneered work in this field.

"At this point the chemists are just trying to understand what the material is. We think we know, but before we go any further we actually want to be able to demonstrate this," Dr Novis says.

"There are almost certainly other sugars that are secreted along with this stuff so it is a complicated mixture of molecules they are trying to characterise".

Lake snot in a test tube.

Lasers and traps

Some of the grant money is being spent on analysis of the slime molecules using lasers, a method called Raman spectrometry.

Professor Keith Gordon's research group at Otago University has analysed many samples, while Landcare Research's Dr Jagath Ekanayake is working on miniaturising this equipment for field use.

This method had found differences between material sourced from different lakes, and also differences between varying depths in a single lake, said Dr Novis.

"The nine traps, short vertical tubes anchored to the lake bottom, are attached to marker buoys to warn boaties of their presence."

DNA/RNA detection

Dr Novis is also developing molecular probes for quantification of *Lindavia intermedia*.

"In this case, we are interested in both the abundance of cells and their slime producing activity," he said. A DNA-based method captures the former, but the latter is trickier, and involves working with messenger molecules that are unstable in the environment. The first step is to freeze samples directly on the boat to prevent their degradation. Once the method is developed, chemical preservation should be sufficient for routine sampling.

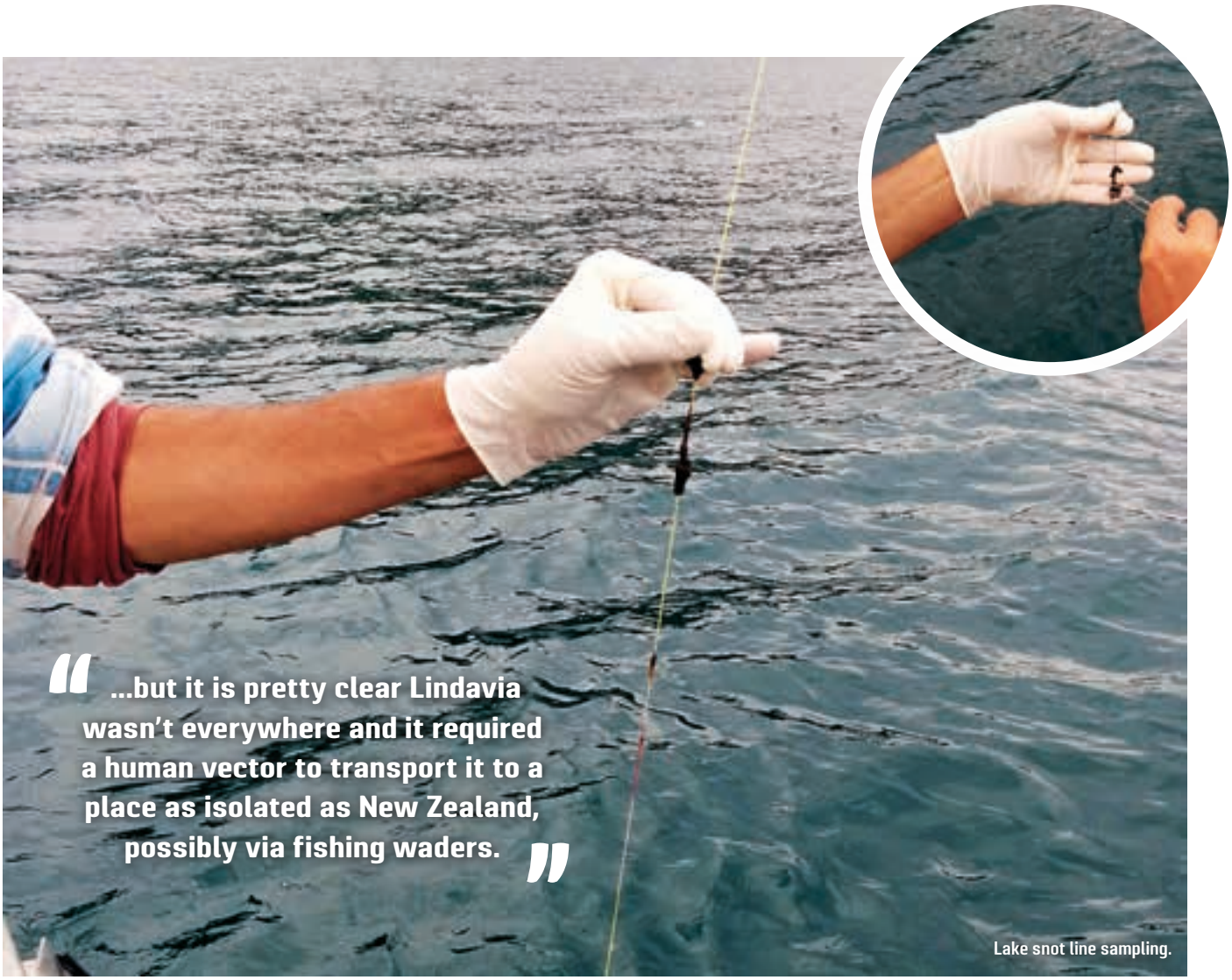
Monitoring

Otago Regional Council, who support this project, undertake monthly monitoring in Lakes Wanaka, Hawea, Hayes, and Wakatipu. The researchers take advantage of this to obtain samples for monitoring purposes. Results show that when Lindavia is most abundant it tends to concentrate in the top 50 metres; otherwise it can be quite uniformly distributed down to at least 100. Samples from Lakes Te Anau and Manapouri, obtained with the help of Environment Southland, continue to be negative for the species.

Origin

Lindavia intermedia was first identified in New Zealand in 2004 about the same time as didymo (*Didymosphenia geminata*), another algal slime that is widely distributed in South Island rivers.

Dr Novis said their arrival at about the same time might be coincidental, but possibly not.



Lake snot line sampling.

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PhD lake ecology student, Sami Khan gathering lake snot.

"The analysis of distribution of microbial species is quite fraught. There is a saying that everything is everywhere and the environment selects, but it is pretty clear Lindavia wasn't everywhere and it required a human vector to transport it to a place as isolated as New Zealand, possibly via fishing waders."

"With didymo it is reasonably widely accepted that phosphorous levels cause the development of its stalks – the slimy stuff.

"When phosphorous gets too low the cells can't grow any more so they pump out slime in the bottom of the cells and grow a big stalk".

Dr Novis said it could also be a similar situation with the *Lindavia* slime.

He said "fine scale" genetic research showed the species found in New Zealand lakes was identical to the snow found in Lake Youngs, a reservoir near Seattle in the US State of Washington. Scientists and researchers in both countries have been sharing data and material.

Trophic status

Two things that need to be distinguished, Dr Novis said, were the presence or abundance of the species and the amount of slime it produces as the two did not correlate.

The *Lindavia* species has been present, for example, in Lake Hayes as long as it has been been in New Zealand but there had never been lake snow there.

"Nutrient runoff has enriched Lake Hayes much more than other lakes where we know it is found."

The trophic status of a lake is assessed using different metrics. One way is to measure the amount of phosphorous and nitrogen in the water for the status to be graded from very clean to very enriched. Lake Wanaka is at the very clean end and described as microtrophic.

"As we are never going to be able to eliminate the species the goal is to figure out whether we can manage the system in such a way that the slime production is either eliminated or minimised", Dr Novis said.

"We have been unable to do that to date because even though we have ways of measuring the algal species itself we haven't had any good methods to measure the quantity of the production of slime."

"With these tools we can measure that component, meaning the slime is the same as the polysaccharides.

"My prediction is that at the end of field testing we will answer the question about whether management intervention can eliminate or reduce lake snow." **WNZ**

Mariner Rise

Where ecology, children and stormwater meet

A small piece of open land on Whangaparaoa Peninsula, north of Auckland, serves the very different needs of a community, ecologists and council's stormwater management responsibilities. Supplied by Boffa Miskell.

It isn't always easy to balance a growing city's need for increased housing density with the desire to provide recreational amenities for those new residents – and be mindful of the ecological imperatives.

But when public and private stakeholders from all sides work together, the results speak for themselves. And, with a bit of creative thinking, a relatively small plot of land can deliver tremendous outcomes on all fronts.

A 2700 square metre piece of open space on Whangaparaoa Peninsula, north of Auckland, is a case in point.

To residents of the nearby Mariner Rise residential development, it's a pretty bit of wetland greenspace just outside the windows, and a pleasant walk through to the nearby bus stop. For the neighbourhood children, it's the opportunity for natural outdoor play.

It's also a flood and stormwater retention basin, and part of a larger stream restoration project that will bring ongoing ecological and community benefits.

"It's the gift that keeps on giving," says Julia Parfitt, chairperson of the Hibiscus and Bays Local Board.

The land, just off Whangaparaoa Road above Arkles Bay on the southern side of the peninsula, had long been mown as an ad-hoc reserve, and was zoned for residential use. There were two stormwater drains running through the space to deal with nearby road and residential run-off.

In 2009, the then-Rodney District Council approved the land for sale subject to further public consultation; and in 2014 options for the layout of the development were presented to the local community, iwi and Hibiscus and Bays Local Board.

Auckland Council Property (now Panuku Development Auckland) received feedback from the local community about what they wanted to see and what they were concerned about. This was incorporated into a plan that – along with residential development – resulted in the creation of a reserve with an adjacent wetland to address stormwater management.

"A big piece of the puzzle was a desire expressed by mana whenua for fauna to be protected and relocated as part of the project development outcomes. They wanted to be confident that the quality of water moving through the area would be improved," says Allan Young, development director at Panuku.

In July 2016, resource consent was granted to McConnell Property to deliver 60 two-, three-, and four-bedroom homes, along with the wetland reserve and playground.

The site presented challenges, as it sits at a confluence of streams where flooding needs to be managed to protect the nearby homes. The project included retention of the two existing streams (one permanent and one intermittent), as well as a new stream diversion within the reserve, which also functions as a flood retention basin.

"In many ways, the reserve site was a hole in the ground," says landscape architect Mark Lewis, of Boffa Miskell. "But there are views of the distant ocean from the top edges; and

at the bottom, the two streams come together and create an island. So, it presented an opportunity to make something quite interesting, in terms of an outdoor area where kids could explore and interact with the wetland and stream environment."

It was important to Julia Parfitt that, along with water management, the site delivered some form of open space.

"The community perceived that, although it was good to have the greater housing options that development brings, there was an overall loss of greenspace."

Transforming the reserve from a grass slope with streams and a few mature trees to an amenity for the community first involved dealing with the ecology. As part of the stream restoration, fish and lizards were surveyed and relocated, and the wetlands were planted to bring birds into the reserve and provide habitat for insects and lizards. Stream-margin sedges and wetland rushes were used along the water's edge.

Where the streams meet, they form an island which can be seen from the banks on either side. The space can be also viewed from the surrounding houses, a community building and bus stop; as well as by children walking to and from school.

Julia wanted to be sure the playground catered to the children who passed through the space on their way to the bus and to school.

"My experience has been that playground designs tend to cater for very young children. So, they often are a space that older primary- and intermediate-school-aged children find boring. I like the way the designers looked at the demographics – which showed that most of the kids were eight years old, and up – and they made a place for them."

This recreation space uses the water as a feature to cater to those slightly older kids – it allows them to use their imagination and to interact with nature. Play items were placed on the island to draw children into the space, with many differently challenging ways for adults and children to reach the island: across boardwalks, or scrambling over logs and stepping stones.

"Not long after the playground opened, a concerned neighbour rang our office and reported that the local kids were playing in the stream and moving some of the rocks," says McConnell Property's development manager Matt Anderson.

Far from being concerned, Matt took the call as a positive sign. "It was always the intention that this would be a place where kids can get their feet wet and their hands dirty. If they're playing in the stream, that tells me that we've got it right – the kids feel like it's their space to explore."

Allan Young has another story that underlines the unexpected benefits of the project's successful integration of ecological considerations.

"One of the best outcomes of the project we noticed while on a site visit. A civil contractor found an eel on another part of the site. With part of the stream restored, he was able to collect the eel and move it to a place where it was out of harm's way."

The retention of the streams and the diversion at Mariner Rise form part of a mitigation transaction that will result in the daylighting of a waterway at nearby Stanmore Bay.

An historical stream running through D'Oyly Reserve will be returned from an underground pipe to a more natural state. This will support plant life, provide a haven for birds, improve the passage for fish, and act as a natural filter to prevent pollutants from reaching the sea.

D'Oyly Reserve backs onto Stanmore Bay School so potential for future development exists within this project such as outdoor classrooms, cycle- and walkways, and additional play areas.

Mark Lewis says, "It's quite a long stream connecting various communities, so rather than doing these mitigation and remediation projects piecemeal, there's substantially more ecological benefit by treating it holistically."

Along with the recreational and ecological benefits, the professional and cross-community relationships that have come out of this project have carried through to other aspects of the community.

"Procuring the plants locally, and using local vendors and contractors has been very important," says Julia. "The project is an example of the benefits that can come from various parts of Auckland Council working together with a private business. Channels have opened up – quite literally, in terms of the waterways – but also between stakeholders, community groups and the companies that have helped make this happen. **WNZ**

Improved oxidation of wastewater treatment

Researchers at the University of California, Riverside, have discovered a method to dramatically improve the way pollutants are removed from wastewater using Advanced Oxidation Processes (AOPs). By **Sarah Nightingale**, *URC Today*.

AOPs are a group of chemical treatment processes that use oxidation to remove organic materials from water.

The reactions are performed by hydroxyl radicals (·OH) created by the decomposition of hydrogen peroxide, a powerful oxidizing agent that is used in both household and industrial settings.

AOP technologies are an appealing way to recycle contaminated wastewater, since the end products of hydrogen peroxide decomposition are water and oxygen.

In reality, though, the reaction is slow, inefficient and requires large quantities of both hydrogen peroxide and ferrous (Fe2+, a divalent iron ion) salt, which serves as a catalyst.

As a catalyst, the ferrous iron should remain chemically unchanged at the end of the oxidation reaction. However, that is not the case, causing the formation of an iron-containing sludge that then must be treated as a secondary pollutant.

Now, UC Riverside researchers have shown that adding an inexpensive co-catalyst can dramatically improve the speed and efficiency of Advanced Oxidation Processes (AOPs).

Yadong Yin, a professor of chemistry in UCR's College of Natural and Agricultural Sciences, and colleagues have shown that adding into the mix another compound – called a co-catalyst – can dramatically improve the speed and efficiency of the reaction.

The action of the co-catalyst reduces the amount of hydrogen peroxide and ferrous catalyst needed and helps prevent the formation of the sludge.

Yin says the co-catalyst, a powdered metal sulfide, is an inexpensive way to speed up the reaction by helping the ferrous catalyst do a better job and persist in its original form, rather than forming the unusable, sludgy by-product.

Yin, an expert on nanomaterials, is now working to create smaller metal sulfide particles with more surface area to further increase co-catalyst performance.

"As the global demand for clean water continues to grow, it is critical that we develop cost-effective technologies to decontaminate polluted water," says Yin.

"This discovery provides the perfect catalytic system to improve an already promising process with applications in industry and municipal wastewater treatment."

Yin's co-opped studies can be found in his paper: *Metal Sulfides as Excellent Co-catalysts for H2O2 Decomposition in Advanced Oxidation Processes*.

www.cell.com/chem/fulltext/S2451-9294(18)30115-3 **WNZ**

Removing pharmaceutical residues from wastewater

Tests carried out at Lappeenranta University of Technology in Finland into pulsed corona discharge (PCD) may significantly reduce the environmental burden of pharmaceutical residues.

According to pilot tests in a chemical technology dissertation by Petri Ajo, (who has a M.Sc. in environmental technology), pharmaceutical residues, their variants and other similar compounds degrade easily from wastewater because the process is non-selective.

PCD is based on the instantaneous contact produced by an electric discharge between a plasma zone and water.

In this phenomenon, water molecules and oxygen in the atmosphere create strong oxidants that degrade organic compounds into water and carbon dioxide. The study examined the formation of oxidants on the plasma-liquid-gas interface and their behaviour in the process.

The study also revealed that the momentary reformation of pharmaceutical substances can be considered a normal part of the reaction chain in the purification process.

It nevertheless makes the comparison of different technologies more difficult and highlights the importance of a non-selective process. Pharmaceutical residues were degraded from the effluents of the wastewater treatment plants of Toikansuo in Lappeenranta and the Rinnekoti foundation in Espoo and from the untreated sewage of the South Karelia Central Hospital.

The results gave important new information on energy efficient oxidation, which is significant also in terms of the further development of the technology.

The efficiency of the process depends on temperature, flow rates, delays, and the location of the process in the wastewater treatment chain.

Ajo's dissertation entitled *Hydroxyl radical behavior in water treatment with gas-phase pulsed corona discharge* has been published in the university's publication series Acta Universitatis Lappeenrantaensis, publication number 793. ISBN 978-952-335-212-4 and ISSN 1456-4491.

The dissertation is available in the LUTPub database of Lappeenranta University of Technology at https://urn.fi/URN:ISBN:978-952-335-213-1 **WNZ**

Global drivers and local responses in BIOSOLIDS REUSE

By **Nathan Clarke** and **Becky Macdonald** from Beca.

Our national brand is associated with being sustainable, clean and green. So is it OK that 60 percent of the residual organic materials produced in municipal wastewater treatment is disposed to landfill[1]?

In a country where our residents and our companies are rapidly adopting eco-friendly initiatives such as use of hybrid or electric cars, and removing single use bags from supermarkets and shops, we must also be getting better at reuse and recycle of the residual organic material from our wastewater facilities – right?

Unfortunately, our recovery and reuse of biosolids has seen essentially zero change since 2013, with around 60 percent of biosolids going to landfill. In addition, statistics such as the amount of biosolids being used for land rehabilitation have fallen, from 10 percent in 2013 to five percent in 2017.

While that seems a bit disconcerting, comparing this country's performance to other nations can provide insight into our performance on a global scale.

How do we perform globally?

Looking across the Tasman, the information provided by the Australian and New Zealand Biosolids Partnership indicates that Australia landfills around two percent of its biosolids, with 75 percent of the biosolids used in agriculture, compared with only nine percent biosolids used in our agriculture.

The two pie charts above clearly show the difference in reuse between New Zealand and Australia, with only two percent going to landfill in Australia. This contrast continues if we look further afield to the USA, where 55 percent of the biosolids is reused beneficially.

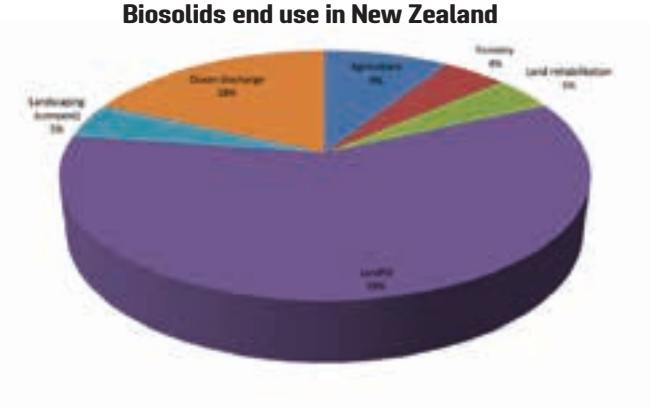
Why the big difference in biosolids management practices?

Exploring these differences requires some historical and regulatory context. Taking the USA as a working example, there are specific reasons why beneficial biosolids reuse on land is comparatively well established. These include:

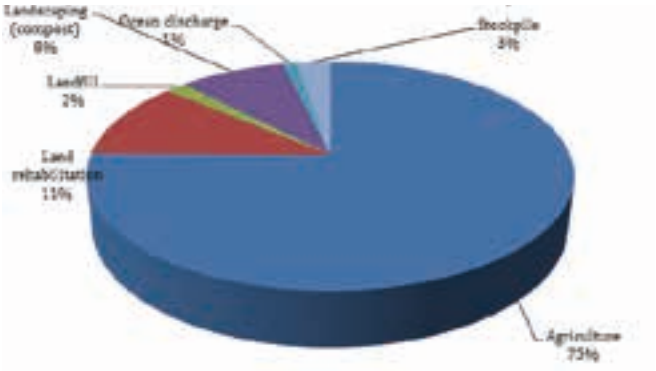
- Early adoption and establishment of beneficial biosolids reuse starting in the 1920s and 1930s[2] has facilitated a strong science research base, development of good practice, and community acceptance over time;
- Federal legislation that mandates biosolids reuse on land nationwide, subject to meeting standards[3];
- Promotion of biosolids reuse on land by the USEPA, an agency which advocates "aggressive outreach ….and strong marketing" as a means to address public concerns[4].

By contrast, in New Zealand, key features include:

Biosolids end use in New Zealand



Biosolids end use in Australia 2016/17



- Late adoption of beneficial reuse, with landfilling traditionally adopted by local authorities due to uncertainties around alternative-use options[5];
- Lack of clear central government policy or law supporting biosolids reuse;
- Complex and costly approvals for biosolids application to land under the Resource Management Act 1991 (RMA);
- Uncertainties, experienced by stakeholder groups, including cultural concerns for Maori[4] which are given status under the provisions and consultation processes of the RMA.

Within the fragmented approach that applies in this country, solutions tend to be developed locally, based on local aspirations, opportunities and constraints. Effective consultation with local stakeholders, including Maori, plays a critical role. There is also the issue of scale, where the economics of biosolids processing and reuse are strongly influenced by community

1. www.biosolids.com.au/guidelines/new-zealand-biosolids-statistics/
2. www.milorganite.com/about-us/history
3. Land Application and Composting of Biosolids, Water Environment Federation, 2010
4. Biosolids Generation, Use and Disposal in the USA, USEPA, 1999
5. Enhancing beneficial reuse of biosolids: A practical guide, (2013) Horswell, Baker, Hill, Langer, Ataria, Leckie, Goven and Lowe
6. Australian and New Zealand Biosolids Partnership - Resources

size. An appropriate solution for Queenstown Lakes District will differ from Auckland or Washington DC.

Is it all bad news?

No, there are some great examples of beneficial reuse here, including:

- Nelson Regional Sewerage Business Unit (NRSBU) applies biosolids as a liquid to local forestry. The NRSBU biosolids scheme has operated successfully for more than 20 years. Research has found a 32 percent[6] increase in forest economic yield from the biosolids application area.
- New Plymouth District Council has developed "Bioboost", a high quality dried pellet product that is sold by a third party in retail stores, used on golf courses and as farm fertiliser.
- Christchurch dries digested biosolids using renewable fuels and the product is used in mine rehabilitation on the West Coast.
- Dunedin operates a waste-to-energy scheme, where biosolids produced at Tahuna are combusted to recover energy and minimise residual solids prior to landfilling.
- A number of councils across the country send their biosolids to vermicomposting, with the resulting product being sold as a fertiliser, or reused locally.

Given this context and the working examples, what does the future hold for us? Various factors come into play.

First, the fragmented approach is likely to remain for the medium to long term. The consultation processes laid down under the RMA are unlikely to change any time soon. Local biosolids issues will continue to require local solutions driven by local economics and with local community input.

Second, increasing urbanisation may drive more intensive management in the main population centres, with the possibility of regional solutions. Emerging technologies may unlock the resource value in biosolids in new and exciting ways, but only if communities are led along this path and wish to embrace them. Such conversations could be difficult.

Third, community drivers for sustainability may intensify. But this could also mean continued landfilling, as landfilling can offer lower carbon emissions than other reuse options in some circumstances, which will be important under the Zero Carbon Act. A holistic carbon footprint-based approach should be applied to "bottom out" the best solution.

So to answer our question from the beginning – is it OK that 60 percent of the residual organic materials produced in municipal wastewater treatment is disposed to landfill?

The RMA provides a national framework for biosolids reuse that is driven by local considerations which will generate solutions utilising a diverse range of technologies.

As a result, our solution will be unique, and can be usefully informed by solutions and technologies used overseas. **WNZ**

Plastic manhole innovation saves dollars and makes a lot of sense

Steve McDonald speaks with the stakeholders at the Omahu Water Services project, Hastings about their application of plastic manhole chamber technology.

Plastic materials have long been recognised for their durability benefits in wastewater applications. Fulton Hogan's recent application of Romold pre-benched plastic manhole chambers in the Hastings Omahu Industrial Bulk Water Services project has proven that the innovative technology has further advantages in the efficiency of installation and safety on site.

"Our decision to use Romold chambers for the Omahu project came from the experience we gained from a previous renewal project. We weighed up the benefits and went for it. Next time it will be a no-brainer," says Joseph Symonds, Fulton Hogan Hastings, Department manager 3-Waters.

"They are faster to install and a lot easier. A typical concrete manhole will take our crew two days to set up, and then a further day is spent on haunching. With Romaold chambers half a day to complete the install is generous."

It is this type of technology that lines up directly with Fulton Hogan's innovation strategy, which is based on helping to solve the problems faced by their customers, staff and the industry and keeping pace with new and emerging technology while ensuring staff are living safely in all they do.

"The business of drainlaying has for a long time been about efficiency. With poly pipes you may pay a little bit more for the materials but you more than make it back with the time saved. Romold manhole chambers fit naturally with this strategy and we have found them to have a very similar economic benefit."

After experiencing problems with concrete corrosion in high H_2S environments the Hastings District Council has developed a preference for more durable solutions.

David James, Hastings District Council, Wastewater Engineering manager, notes; "Long term durability is a key interest for us, and this is where plastic has an advantage over concrete.

"The ease of installation benefits have not been overlooked,

there is a time savings when using this technology and it is significant. This has resulted in contractors requesting to use the technology."

Stantec noted comparable motivations that led to incorporating the technology into their solutions for Omahu and other Hastings projects.

"Our main driver was for a product that would be resilient against septicity. We felt confident in what we saw from the Romold product and knew that this would be a good solution for resistance to H_2S corrosion," says Stephanie Thompson, Stantec, Civil Water Team Lead.

"Supporting the interests of the contractor by specifying a material with installation benefits was a further motivator.

Joseph Symonds says the Omahu project has become a showcase for the Fulton Hogan Hastings 3 waters team.

"We had the Fulton Hogan Exec team come through on a site visit and they were blown away with what they saw. I believe that it was the first time they had seen a plastic manhole being installed and certainly it was their first time seeing a manhole being moved by hand. The safety benefits were extremely obvious.

"With any advancement in technology there is an associated learning curve. The installation itself is straightforward, it is common sense and the installation instructions provided are clear and easy to follow.

"Once you've done one it is exactly the same for the next

Fulton Hogan site.

chamber. The learning is more in the way that we approach the job. With concrete we have the option of dropping it into place and working it out from there. Plastic chambers require some attention to detail ahead of time, they need to be specified so that the right solution is delivered.

"For us this isn't too much of a problem as these days all of our jobs rely on a higher level of project management to optimise our processes and to achieve efficiency.

"We have found that good communication ahead of construction will save us time during the process, and importantly it helps to reduce unnecessary lost time chasing up incidentals." **WNZ**

LittaTrap meets North American treatment standards

Canadian testing of the LittaTrap demonstrated high sediment removal in addition to high gross pollutant capture, explains **Mike Hannah,** Managing and Technical director of Stormwater360.

In December 2017 the LittaTrap was independently tested in Toronto, Canada at Good Harbour Laboratories.

This innovative catchpit insert from Stormwater360 New Zealand was tested for sediment efficiency, gross pollutants capture and scour potential.

The testing protocol was based on a combination of the New Jersey Department of Environmental Protection (NJDEPT), Canadian Environmental Technology Verification (CETV) and Californian Transport Authority (Caltrans).

These protocols are used to certify the performance of treatment devices in North America in meeting regulatory requirements.

The first test to understand sediment efficiency used a standardised synthetic stormwater sediment to evaluate removal rates.

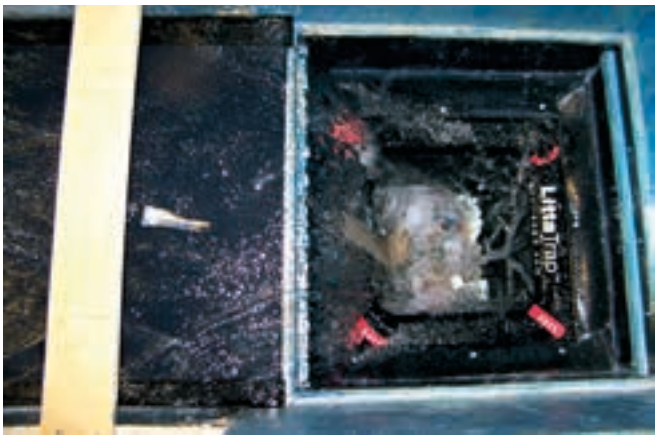
The test sediment was the standard test sediment under the Canadian ETV and New Jersey Manufactured Treatment Device protocols. The test sediment is very fine with a d50 of 75 microns and with no particles over 1mm.

In the test, the LittaTrap removed over 50 percent of the suspended sediment. Inflow into the catchpit is directed onto the LittaTrap, which dissipates the energy of the incoming water and distributes the flow across the entire surface area of the sump. This increases the settling ability of the existing catchpit sump and the LittaTrap captures this fine sediment in the sump of the catchpit.

By removing over 50 percent, the LittaTrap qualifies as a pre-treatment device with equivalent performance to end of pipe Hydrodynamic Separators and Gross Pollutant Traps.

Testing also included evaluating the system for wash-out or scour in large or more extreme rainfall events. The objective of this test was to quantify and characterise the amount of previously captured sediment that can be re-suspended and washed out during periods of high flow.

For treatment devices to be placed online they must not release more than the average 20mg/l at 200 percent of its treatable flow rate. For this test, the sump of the catchpit was filled to 50mm below the outlet with test sediment.



Far left: Laboratory sediment removal testing set up.
Left: Test sediment particle size distribution.

This is the suggested maintenance depth of the sump with a LittaTrap installed. The flow rate through the system was gradually increased over the test to a maximum of 15.6 l/sec. The average released concentration was 7.8-mg/l.

The final test conducted on the LittaTrap was the Trash Test. This performance test assessed the LittaTrap's ability to remove gross pollutants from stormwater runoff and evaluates the systems-clogging capability and hydraulic performance. This test is based on work reported in the Caltrans document "*Laboratory Testing Of Gross Solids Removal Devices*".

Synthetic gross pollutants were added to the testing runoff and included: paper, plastic sheets, cloth and plastic film contaminants that can easily stick to a screen and cause a treatment device to "blind".

In this test, the LittaTrap caught 99.4 percent of the gross solids @ 15 l/sec in a test that lasted over one hour.

While originally developed to be an 'Easy to Maintain, Low-Cost Solution' to trap plastics at the source, these results show the LittaTrap also greatly enhances the performance of the catchpit to a level where it is equivalent to a Gross Pollutant Trap in removing fine suspended solids.

The LittaTrap is an ideal solution for pre-treatment, and by removing over 50 percent of total suspended solids the system can extend the maintenance frequency of down stream treatment devices such as wetlands and filters. This in turn greatly reduces the operational costs of these devices.

For more information please contact sales@stormwater360.co.nz or visit our website www.stormwater360.co.nz

The only other New Zealand catchpit insert that has undergone such rigorous and scientific testing is the Stormwater360 EnviroPod, which shows our continued dedication to true, independent, scientific evaluation to international standards. **WNZ**

We need your support please

PHOTOS COURTESY OF OXFAM

"I'm worried about my home. I'm afraid that my tent will be flooded, it may be blown away by the wind.

"I will have problems collecting clean water, I don't know how I will manage.

"What can I do?" says Laila, a Rohingya refugee who fled violence in her home country of Myanmar into neighbouring Bangladesh – and while heavily pregnant.

She is one of almost 700,000 Rohingya people who have fled to Bangladesh since last August.

Monsoon rains have started falling over the refugee camps where thousands of houses are sprawled across hillsides and in valleys.

Aid agencies working in the camps share concerns that the monsoon rains bring with them a risk of a second disaster in this already desperate situation, with these seasonal rains threatening water supply contamination and disease outbreak.

Oxfam and its supporters such as Water New Zealand is there – and, alongside keeping people safe, our priority is ensuring families can safely access clean water points and sanitation facilities, and minimising the risk of waterborne disease.

We're providing clean water to families living in camps by constructing wells, tap stands, water pumps and water tanks.

In Unchiprang camp, we're supplying 300,000 litres of clean drinking water a day that refugee families, as well as local communities in the Teknaf area, can access.

We're ensuring people have access to sanitation and hygiene facilities by constructing latrines and showers. Our teams are making sure these are accessible and safe for women, as lengthy travel to and from toilets after dark puts them at risk.

We're reducing the risk of waterborne disease by installing a sewerage facility to serve 100,000 people and working to prevent waste escaping from latrines, as escaped excrement is likely to contaminate water supplies.

"I am very worried about the rainy season. We are afraid of landslides," says Rashida, who lives with her newborn son in Kutupalong camp.

"We are afraid of cyclones. I don't know how I'll be able to fetch water."

We're working as quickly as we can, but the rain is already falling and it's not relenting. If you wish to make a contribution to support this important work, follow this link: www.oxfam.org.nz/refugees **WNZ**

PHOTOS COURTESY OF TOMMY TRENCHARD/OXFAM.

1. Laila, Cox's Bazaar refugee camp, Bangladesh. 2. Rashida, Cox's Bazaar refugee camp, Bangladesh. 3. Oxfam-built latrines in Kutupalong camp, Bangladesh, constructed to help keep people healthy, reduce the risk of disease, and restore dignity for women and girls. 4. A 10,000 litre water tank was rolled into Unchiprang camp, Bangladesh, and now forms part of Oxfam's water treatment system providing 300,000 litres of clean water a day to the camp.

Water quality, designations, and High Court comments

By **Helen Atkin**s, partner, **Nicole Buxeda**, solicitor and **Rowan Ashton**, solicitor, of Atkins Holm Majurey.

In this publication we look at the Action Plan for Water Quality 2018 and the principles arising out of this. We also detail two recent decisions of the High Court, *Okura Holdings Limited v Auckland Council* [2018] NZEnvC 78 and *Titirangi Protection Group v Watercare* [2018] NZHC 1026, and the elements of these decisions pertaining specifically to water matters.

Good Farming Practice – Action Plan for Water Quality 2018

The focus on the health and swimmability of rivers in New Zealand took centre stage in the 2017 election, and the Good Farming Practice – Action Plan for Water Quality 2018 (Action Plan) released on 5 June 2018, is a policy step towards supporting farmers and growers to implement good practice principles that will reduce the impacts of farming activities on freshwater. It builds on the Land and Water Forum's recommended approach to management practices for water.

The Action Plan was developed by a Governance Group including representatives from various industry players (including Federated Farmers, Beef + Lamb New Zealand, Horticulture New Zealand, Dairy NZ, and Irrigation New Zealand), local authorities (including Greater Wellington Regional Council, Waikato Regional Council, and ECAN) and the Ministry for the Environment (Water Directorate)). The Action Plan relies on the interests represented in the Governance Group to ensure support at a farm level, at a regional/catchment level, and at a national level.

The Action Plan is a voluntary commitment, and aims to accelerate uptake of good farming practices, and measure, access and communicate the progress on this uptake.

The outcomes sought under the Action Plan include:

a. Supporting well-informed and competent land users using Good Farming Practices successfully to improve rural water outcomes at the farm level arising from their activities;
b. Enabling sectors to articulate and demonstrate their water stewardship story;
c. Ensure councils and communities are confident that land users are using Good Farming Practices to improve water outcomes.

The Action Plan sets out Good Farming Practice Principles which recognise that New Zealand comprises a wide variety of land uses, types and environments. Regions and sectors will have the freedom to select the most applicable Practice Principles in the area or industry to focus on.

The collaborative nature of this project and the focus on supporting farmers to make changes speaks to the determination to make this a long term culture change. The national implementation and actual culture changes achieved by the Action Plan will be interesting to see and, thanks to the focus on measuring, it will be easy to track the success of this initiative.

Watercare Huia Treatment Plant designation interpretation upheld

Titirangi Protection Group v Watercare [2018] NZHC 1026 was an appeal from an Environment Court decision declining a declaration that the designation limited water treatment facilities to the footprint of the existing plant. The High Court in *Titirangi Protection Group v Watercare* upheld the Environment Court's interpretation that the Huia and Nihotupu water treatment plant designation provides for construction of a replacement plant on the designation site beyond the footprint of the existing plant.

The background to the case was that Watercare had determined it was necessary to replace the Huia Treatment Plant. Even with careful maintenance it was unlikely that the Huia Plant would be able to perform its current role for more than five to 10 years. Watercare concluded that traditional treatment processes used in the existing plant should be replaced by advanced processes more appropriate for the treatment of water received from the dams that supply it. The decommissioned Nihotupu Filter Station was also on the site subject to the relevant designation.

Watercare proposed to relocate the bulk of the water treatment processes carried out at the Huia Plant to a new plant to be built on a 4.2 hectare parcel of land adjacent to the land on which the Huia Plant is located. It intended to relocate primary water treatment processes, chemical storage and administrative facilities to the new site. Other systems would remain on the existing Huia site. Surplus assets on the existing site that are not considered to be heritage assets would be demolished. Once the new plant has been completed, the three plants would operate together as a single water treatment facility.

The land on which the two existing plants were located was subject to a designation known as Designation 9324. The designation applied to three parcels of land encompassing a total of 57 hectares. The first was a four hectare parcel of land on which the existing Huia Station and associated pipelines were located. The second was an adjoining 4.2 hectare parcel of land that was covered in regenerating bush. This was the land on which the new plant was proposed to be built. The remaining parcel of land comprised

49 hectares. The decommissioned Nihotupu Filtration Station was located on one corner of this parcel of land, as well as a pipeline network. Under the heading "Purpose", the designation stated "Water supply purposes – Huia and Nihotupu water treatment plants and associated structures". The issue was whether these words should be treated as defining where treatment plants were permitted by the designation, or whether the designation covered a new water treatment plant outside the existing footprint but within the designated area.

The designation was subject to three conditions. The first related to matters that Watercare was required to address or include in any outline plan of work it might submit to the Council. The second related to sedimentation and erosion control measures for any earthworks to be carried out on the designated site. The third comprised a prohibition on future works that might adversely affect those elements of the Filter Stations that are identified as having heritage value.

There was no dispute regarding the test to be applied when interpreting the scope of a broadly worded designation. As confirmed in numerous cases, the test is what an ordinary, reasonable member of the public who is considering a district plan would have taken from the designation.

The decision of the Environment Court did not accept that the description of the two areas as Huia and Nihotupu treatment plants meant that they are constrained to the existing buildings or footprints. Huia and Nihotupu were references, not to these particular buildings, but to areas that are the sources of the water. In both cases the water supply dams Huia and Nihotupu were not within the designation, but were in different parts of the catchment.

The Environment Court held that the treatment of water is a process involving many stages and parts. Over the years, the requirements for water quality have changed, and this has added elements such as testing laboratories, chemical additions and, more latterly, UV and microbiological treatment of waters through various means. New technology is being developed all the time, including membrane filtration and other similar methodologies. In light of the extensive area covered by the designation, and the fact that conditions pertaining to the designation contemplated future works on the designation site, the Environment Court held it was unreasonable to expect that such works would be confined to the foot print of existing buildings.

The High Court agreed with these findings and held that the Environment Court decision suffered from no error of law. The High Court held that the reasonable and ordinary person would know that the treatment of water from its raw state to a product suitable for human use and consumption will require a number of steps to be taken. These will vary in nature and intensity as knowledge and technology advance, and as the demand for water rises with the steady increase in Auckland's population. That person would also know that, in common with plant used for most industrial and commercial purposes, the plant installed at Watercare's sites will have a finite working life. New and more advanced water treatment methods will inevitably emerge as time goes on. Even if the person was not aware of that fact, they would know that all water treatment plants eventually become obsolete or unable to process water in an appropriate or economic way. The ordinary and reasonable person would therefore anticipate the eventual construction of one or more new facilities to either replace the existing facility or, as is now proposed, to operate in conjunction with it.

The ordinary and reasonable person would not conclude that any new or replacement facility would necessarily be located on the same site as the Huia or Nihotupu plants. That would be inherently unlikely in the case of the construction of an entirely new plant to operate in conjunction with the existing plant. The person would know that Watercare has required 57 hectares to be designated for water treatment purposes. They would therefore appreciate that Watercare is likely to build the new facility within that area and most probably in relatively close proximity to the two existing sites. This would enable the new facility to take advantage of the area's proximity to the sources from which water was to be drawn for the new plant. The ordinary, reasonable person would understand the designation permitted the construction of a new water treatment facility within the area designated for that purpose but not in the same position as the two existing sites.

This case provides a pragmatic approach to the interpretation of broadly worded designations for water treatment purposes.

High Court decision – *Okura Holdings Limited v Auckland Council* [2018] NZEnvC 78

On 6 June 2018 the Environment Court released its decision declining the appeal by Okura Holdings and others against decisions of Auckland Council on the Proposed Auckland Unitary Plan (PAUP). The appeal sought to enable urbanisation of 130 hectares of live zoned land within the Auckland urban area, resulting in approximately 750-1000 dwellings along with open space of approximately 42 percent of the site, a walkway extension to the park zone and retention and enhancement of various natural features of the site.

The appeal primarily concerned the issue of where the Rural Urban Boundary (RUB) should lie in respect of the Appellants' properties. The PAUP states that the RUB "identifies land potentially suitable for urban development". At Okura the notified Plan included land on the south side of the ridgeline of Vaughans Road as being within the RUB but excluded the appellant's land on the north side of the ridgeline. The Independent Hearings Panel (IHP) recommended that the RUB should be extended northwards to the Estuary's southern shore to include the Appellants' land. The Council did not accept the recommendation of the IHP and decided to retain the RUB as notified and as a result the landowners appealed.

Relevant to this decision to not extend the RUB is the existence of the Long Bay – Okura Marine Reserve which has implications for construction and occupation on the land, and the bordering Long Bay Regional Park and Okura DOC Scenic Reserve. These three sites are overlaid with two landscape areas of significance in the Auckland Unitary Plan.

In light of the proposed urbanisation of the land, the issues considered by the Court included earthworks and sediment discharges, stream modifications, coastal sediment dispersion modelling, metal contaminant discharges and coastal dispersion, marine benthic ecology, avifauna, freshwater and terrestrial ecology, water supply and wastewater disposal, traffic and transportation, economics, natural character and landscapes and open space factors.

The Court heard extensive expert evidence and reached the following key conclusions:

- The Groundwater Loading Effects of Agricultural Management Systems model provided a reasonable basis for understanding likely sediment yields and adverse effects from these yields.
- That while a degree of uncertainty still exists around the potential impact of climate change, this uncertainty must be considered within the context of the sediment discharge which could be generated.
- The Court considered whether the effects of discharges (including metal contamination from heavy metals, and sediment) from the proposed development may cause the benthic health of the Estuary to reach a tipping point, and consequently considered whether a precautionary approach should apply. The Court found that given the potential for there to be unknown cumulative and other stressor effects of the sediment, heavy metal and other discharges on the estuary, a precautionary

approach should apply when assessing the effects of the discharges.

- The proposed development included 2.7 kilometres of the streams to be realigned or enhanced, and 1.5 kilometres of intermittent or ephemeral streams to be reclaimed. The realignment would require effective erosion control measures to prevent sediment run-off into the estuary, and while the Court was satisfied that the reclamation of streams could be satisfactorily designed to control erosion and discharge, the Court was dissatisfied with the lack of certainty as to what party would be responsible for the ongoing maintenance of the realigned stream system and considered that ongoing stream maintenance was vital to ensure healthy rivers and minimisation of discharge of sediment into the estuary.
- The Court considered that the potential adverse sedimentation effects were sufficiently credible to attract weight, and overall the Court was not confident that the marine benthic ecology or avifauna would be safeguarded from significant adverse effects of the proposed development, or even that lesser adverse effects would necessarily be avoided, remedied or mitigated.
- The Court determined that the non-market costs of the effects of the proposed development on the biophysical environment including freshwater and marine ecology should be taken into account in the overall economic evaluation of the proposed development.
- While the Court accepted that the proposed development is a more efficient use of the land in purely monetised economic terms, it found that the economic benefits of development would be minimal in the wider scheme and it was unnecessary to include the land within the RUB to meet objective and policy requirements to provide for future urban growth.
- The Court considered that while the coastal and riparian enhancement measures proposed have the potential to mitigate some adverse effects of the proposed development, these mitigation measures are overwhelmed by the extent of the development proposed.
- The natural character and landscape effects of the proposed development on the land and environment were held to be inappropriate due to the high natural character and landscape values which require protection from inappropriate subdivision, use and development. The Court determined the estuary was unique as one unaffected by urban development near Auckland, that the protective measures achieve a distinct sense of place, and concluded that the development will diminish the natural biophysical character and perception of naturalness significantly and such urbanisation will have high adverse effects (which are not adequately mitigated) on the amenity and experiential values of users of the Regional Park. The Court also held there are high adverse effects within the coastal environment and Outstanding Natural Landscape (ONL) or High Natural Character (HNC) areas and therefore the proposed development is inappropriate in terms of sections 6(a) and 6(b) of the RMA.

This decision is significant as it illustrates the application of strong protective directions in the Regional Policy Statement provisions of the Auckland Unitary Plan. Any future proposals to bring additional land within the RUB will need to show that adverse effects of urbanisation will be avoided on environmental values scheduled for protection in the plan. **WNZ**

Water purification breakthrough

The ability to create clean, safe drinking water using only natural levels of sunlight and inexpensive gel technology could be at hand, thanks to an innovation in water purification. Sourced from the University of Texas.

According to the United Nations, 30,000 people die each week from the consumption and use of unsanitary water.

Although the vast majority of these fatalities occur in developing nations, the United States is no stranger to unanticipated water shortages, especially after hurricanes, tropical storms and other natural disasters that can disrupt supplies without warning.

Led by Guihua Yu, associate professor of materials science and mechanical engineering at The University of Texas at Austin, a research team in UT Austin's Cockrell School of Engineering has developed a cost-effective and compact technology using combined gel-polymer hybrid materials.

Possessing both hydrophilic (attraction to water) qualities and semiconducting (solar-adsorbing) properties, these 'hydrogels' (networks of polymer chains known for their high water absorbency) enable the production of clean, safe drinking water from any source, whether it's from the oceans or contaminated supplies.

The findings were published in the journal Nature Nanotechnology.

"We have essentially rewritten the entire approach to conventional solar water evaporation, " says Yu.

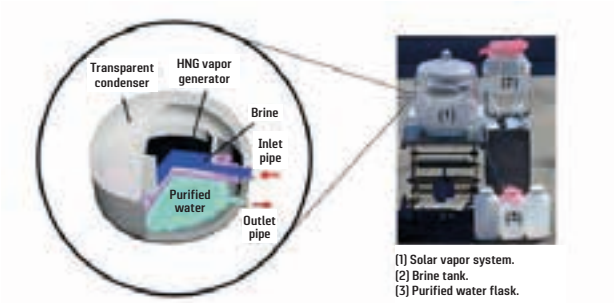
The Texas Engineering researchers have developed a new hydrogel-based solar vapour generator that uses ambient solar energy to power the evaporation of water for effective desalination.

Existing solar steaming technologies used to treat saltwater involve a very costly process that relies on optical instruments to concentrate sunlight.

The UT Austin team developed nanostructured gels that require far less energy, only needing naturally occurring levels of ambient sunlight to run while also being capable of significantly increasing the volume of water that can be evaporated.

"Water desalination through distillation is a common method for mass production of freshwater. However, current distillation technologies, such as multi-stage flash and multi-effect distillation, require significant infrastructures and are quite energy-intensive, says Fei Zhao, a postdoctoral researcher working under Yu's supervision.

"Solar energy, as the most sustainable heat source to potentially power distillation, is widely considered to be a great alternative for water desalination." The hydrogels allow for water vapor to be generated under direct sunlight and then pumped to a condenser for freshwater delivery.



Inside a ' Hierarchically – Nanostructured Gel' Vapor Generator. UT Austin.

The desalinating properties of these hydrogels were even tested on water samples from the salt-rich Dead Sea and passed with flying colors. Using water samples from one of the saltiest bodies of water on Earth, UT engineers were able to reduce salinity from Dead Sea samples significantly after putting them through the hydrogel process.

In fact, they achieved levels that met accepted drinking water standards as outlined by the World Health Organization and the U.S. Environmental Protection Agency.

"Our outdoor tests showed daily distilled water production up to 25 litres per square metre, enough for household needs and even disaster areas," says Yu. "Better still, the hydrogels can easily be retrofitted to replace the core components in most existing solar desalination systems, thereby eliminating the need for a complete overhaul of desalination systems already in use."

Because salt is one of the most difficult substances to separate from water, researchers have also successfully demonstrated the hydrogels' capacity for filtering out a number of other common contaminants found in water that are considered unsafe for consumption.

Yu believes the technology can be commercialised and is preparing his research team in anticipation of requests from industry to conduct scalability tests.

The potential impact of this technology could be far-reaching, as global demand for fresh, clean water outpaces existing natural supplies.

A patent application has been filed, and Yu has teamed up with the university's Office of Technology Commercialization to assist with the licensing and commercialisation for this novel class of hydrogels. **WNZ**

For more information:
www.nature.com/articles/s41565-018-0097-z

Tackling wastewater emissions

More than just a smelly problem

Lesley Smith outlines Water New Zealand's submission to the Productivity Commission on managing wastewater treatment plant emissions.

Wastewater treatment plant operators are used to thinking about the air emissions around wastewater treatment facilities. Odour from a wastewater treatment plant can be one of the surest bets for annoying your neighbours. However, a less commonly considered impact from the gases coming off our wastewater treatment plants is the one they have on climate change.


Lesley Smith

In greenhouse gas accounting parlance these are commonly referred to as "fugitive emissions". Wastewater fugitive emissions are principally composed of methane and nitrous oxide, both potent greenhouse gases. Methane has approximately 25 times the greenhouse gas warming potential of carbon dioxide and around 298 times the potential of nitrous oxide.

The impact of our wastewater treatment plants became the subject of some frenzied research around the Water New Zealand office when the Productivity Commission, looking into transitioning New Zealand to a low emissions economy, recently posed the question; should wastewater treatment plants be included in the Emissions Trading Scheme?

The response from our members was mixed. Many pointed out that as the water sector sits on the front line of climate change impacts, all measures (including inclusion in the emissions trading scheme) should be on the table.

Others were more wary, asking; do we even know enough about our wastewater emissions for these to be included in the emissions trading scheme? What opportunities would we have to reduce emissions anyway?

It turns out the answers to these questions are; not really and heaps, respectively.

At an aggregate level, we have some informed guesses about roughly the size of our emissions (see breakout box for more detail). At an individual plant level, however, the picture becomes a little more woolly.

Take a quick browse through local authority greenhouse gas inventories and you might notice a stark absence of information on wastewater treatment plant emissions. To anybody who has compiled a greenhouse gas inventory this will probably come as no surprise.

Nowhere is New Zealand-specific guidance material on how to determine wastewater fugitive emissions published. For authorities using land treatment systems, a style rarely used outside of New Zealand, little exists in the international literature either.

However, not all authorities have let the absence of local guidance stop them from attempting to measure emissions. The Intergovernmental Panel on Climate Change document, *Guidelines for National Greenhouse Gas Inventories 2006* contains methods for determining wastewater treatment plant emissions. With a few exceptions these mostly work in New Zealand as well.

Our country's biggest wastewater treatment plant operator, Watercare, runs a highly robust emissions accounting framework. Emissions sources as diverse as embodied carbon in lime, biosolids, sludge dewatering and septic tanks are all accounted for on an annual basis, providing a potential example for other authorities who wish to get a better grip on their own wastewater emissions.

Water New Zealand has suggested that an important first step towards tackling wastewater treatment plant emissions is to get a better handle on our emissions and greenhouse gas methodologies for some of New Zealand's particular treatment processes (especially land application).

For this to happen we can't rely on local councils alone. Understanding carbon and nitrogen cycles is a difficult task, one where detailed expertise sits with central government agencies and academia. The mantra that you can't manage what you can't measure springs to mind.

If you have made it this far through the story – "you're suggesting accounting?" – I hear you yawn. Accounting is merely the boring key to understanding and unlocking the many exciting emissions reduction opportunities that exist at wastewater treatment plants.

Our submission broadly suggests four categories of opportunities; energy recovery, energy efficiency, onsite effluent emissions labelling, and possibly nitrous oxide reduction through recovery systems. (See the breakout box for some of the more universally-applicable possibilities.)

Circling back to where we began, would including wastewater treatment plants in the emissions trading scheme bring about such changes? And at what cost?

Wastewater treatment plants have the important purpose of protecting public health and the environment, and accordingly treating effluent needs to remain the focus of their operation.

Emissions reduction opportunities at domestic wastewater treatment plants

Energy Recovery

- Anaerobic digestion;
- Biosolids energy recovery;
- Heat recovery; and
- Conversion into fuel cells.

Energy Efficiency: Opportunities for our domestic wastewater plants

- Wastewater pumping optimisation;
- Aeration system optimisation, addition;
- Pre-anoxic zone for biological nutrient removal;
- Flexible sequencing of aerations basins; and
- High-efficiency UV systems.

Wastewater treatment plant emissions in New Zealand. How big a deal are they?

In 2016-17 fugitive emissions from wastewater treatment and discharge contributed 396.8 kt CO_2-e to national emissions.

The energy consumption of wastewater treatment systems (which includes pumping in reticulation networks in addition to wastewater treatment) used upwards of 1,302,007 GJ of energy in 2016-17, corresponding with approximate emissions of 43 kt CO_2-e.

To put these figures in context, New Zealand's gross greenhouse gas emissions were 78.7 Mt CO_2-e in 2016, putting the contribution of wastewater treatment plant fugitive emissions and wastewater system energy use at 0.35 percent and 0.05 percent of all national emissions respectively.

There are many trade-offs between energy, carbon and effluent quality. For example, energy UV disinfection systems, or aerated lagoons, improve effluent quality but come with a high energy penalty. Any moves that force trade-offs with public health in the name of emissions reductions should raise eyebrows.

Add to this, the existing pressures on already stretched local council resources and staff time and there is a question about whether a price signal alone is enough to create change in local authorities. The risk is that another line item is simply passed on through the rates bill to local communities. **WNZ**

- We'd love to hear from you if you have any further thoughts about what the sector should be doing to manage wastewater treatment plant emissions. Water New Zealand's full submission to the Productivity Commission is available on both the Water New Zealand and the Productivity Commission's websites.

- Lesley Smith is technical co-ordinator at Water New Zealand. lesley.smith@waternz.org.nz

Follow those BATS

Theresa Laverty, a PhD candidate in the Department of Fish, Wildlife, and Conservation Biology at Colorado State University looks at a flying mammal that could lead the way to survival in areas where water is scarce. Article first published in *The Conversation*.

Desert life depends on reliable access to water. In Namibia's stark Namib Desert, where I spent 18 months doing research for my PhD, wildlife concentrates around natural springs. Increasingly, animals there also rely on man-made ponds intended for livestock.

But water can vary both in quantity and quality, and animals have different needs. Some species, like the kangaroo rat, can survive without drinking water for years by obtaining it instead from its food. More often, the movements of desert animals are restricted by reliable access to water.

Part of my research examines relationships between bat species and water quality in an African desert.

Based on my observations, I believe that in arid places, people may be able to locate usable water sources and detect changes in the quality of sources they are already using by observing bats.

Water can be hard to access in rural areas. A young Namibian can be required to travel two miles round-trip every day to collect water for drinking, cooking and cleaning.

Measuring pollution with canaries, moss and fish

People have used plants and animals as environmental indicators for many years. Most famously, miners carried canaries into coal mines with them to detect toxic gases, including carbon monoxide, before the development of modern safety equipment.

Today, scientists use many living organisms in their natural habitats to assess changes in the environment. Good bioindicators are typically species that are abundant, common and whose lives are relatively well-understood but also are sensitive to specific disturbances or stresses, such as water scarcity or pollution.

For example, some researchers infer pesticide concentrations by monitoring the population sizes and body conditions of amphibians and fish-eating birds. Plants are useful bioindicators for many types of air pollution because they absorb air through their leaves. Similarly, fish and other small aquatic organisms can be effective bio-indicators of water pollution.

Clean drinking water is scarce and dwindling

According to the United Nations, global water use has grown at more than twice the rate of human population growth over the past century.

In many places groundwater is being used at faster rates than it can be replenished. And water quality is declining. At least a dozen major cities could face limits on water use in the next several decades.

Water quality typically worsens as humans pump up increasing quantities from underground. Salt and toxic substances become more concentrated in the remaining groundwater as its volume decreases. At the surface, pollution from agriculture, mining and human waste reduces water quality in rivers, lakes and ponds.

Government agencies in developed countries monitor and treat freshwater supplies to ensure that they meet drinking water standards designed for humans and livestock. Costs for laboratory analysis often start at US$100 or more per sample and quickly add up. Therefore, scientists often resort to biological indicators, such as aquatic insects and fish, to assess water quality.

In the Namib Desert, pools of freshwater are rare and isolated. The ephemeral rivers of Namibia flow only a handful of days each year, so it is very hard for aquatic insects and fish to travel between bodies of water.

But since bats can fly, they can find freshwater sources over large areas, and may visit multiple ponds in a single night. One question I am studying is whether bats are more likely to travel to seek out high-quality water than to find food.

There are more than 1300 bat species worldwide, living in diverse environments on every continent except Antarctica. They pollinate plants, disperse seeds and consume insects – including disease-spreading vectors like mosquitoes.

Because their wings are large and uninsulated, bats are vulnerable to dehydration. Even the most desert-adapted species need water. Water quality affects them directly when they drink and indirectly when they consume insect prey, many of which spend part of their lives growing in water. This makes bats excellent indicators of water quality. In extreme cases, they have died after drinking water contaminated with insecticides or heavy metals.

To find high-quality surface waters, people could observe bat activity levels using acoustic detectors to record bats' echolocation calls. Although mostly inaudible to humans, people can typically identify bats to the species level by their calls. Monitoring species that are associated with high-quality water over time would help municipalities detect changes in water quality. During my time in Namibia, I observed that activity by all local bat species dwindled at springs with high salt concentrations.

Preliminary analyses suggest the long-tailed serotine (*Eptesicus hottentotus*) could indicate the presence of high-quality water in the northern Namib Desert. This species was found to be more active at ponds farther from human settlements with minimal pollution.

Water chemistry affects different bat species in different ways. For instance, one study found that certain species in Israel's Negev Desert, such as the lesser horseshoe bat (*Rhinolophus hipposideros*), avoided drinking water of lower quality, while other species appeared to be more pollution-tolerant.

Scientists are still trying to discern whether and how well bats tolerate salty drinking water.

A study from Western Australia suggests that elevated salt levels in surface waters due to gold mining may decrease bat activity, foraging and drinking. If this is true, people living in those areas could detect changes in water quality, such as increased salinity, by gauging activities and drinking patterns of sensitive bat species.

With new tools such as bat detectors for smartphones, this is becoming easier and cheaper than testing water samples in labs.

Water quality near and far

Water quality challenges aren't limited to distant deserts or cities in arid regions such as Cape Town, South Africa.

In my New Jersey coastal hometown, production wells pump freshwater from about 900 feet below ground out of the Kirkwood-Cohansey aquifer system. As water levels decline in the aquifer, saltwater enters pores previously filled with freshwater. Saltwater is currently approaching my county's wells at a rate of about 300 yards per year.

In addition to groundwater pumping, paved surfaces and de-icing road salts have increased salt concentrations in bodies of freshwater across the United States, threatening the state of our drinking water at vast scales.

Bats' potential as environmental indicators is just the latest reason for studying and conserving these important creatures.

Worldwide, about one-third of bat species are endangered, vulnerable to extinction or "data deficient", meaning that scientists know too little to make judgments about their status.

But with effective protection, monitoring sensitive bat species soon could be a viable way to find clean water in the far reaches of remote deserts – or even the rural United States. **WNZ**

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