water

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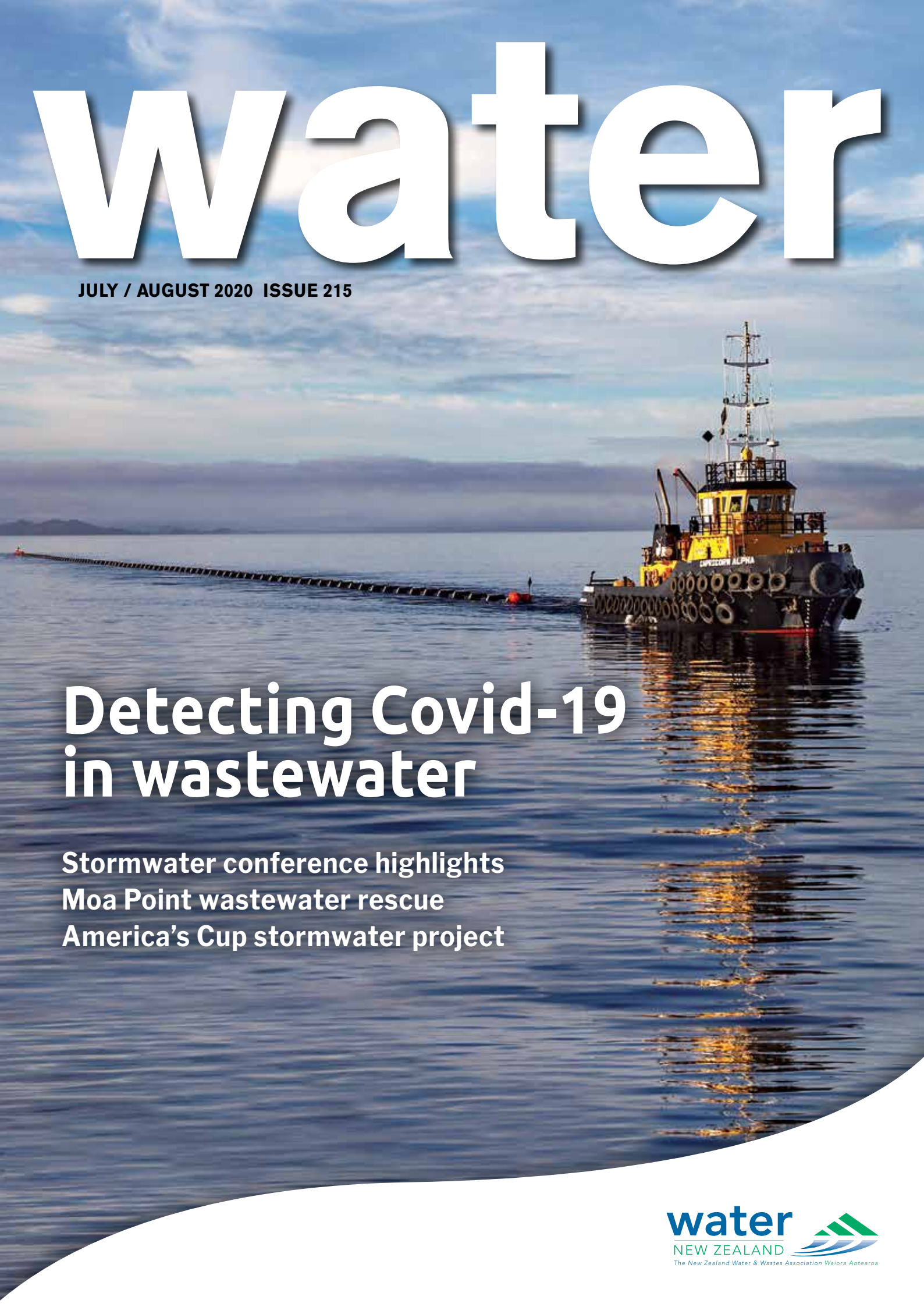

Detecting Covid-19 in wastewater

Stormwater conference highlights
Moa Point wastewater rescue
America's Cup stormwater project

water NEW ZEALAND
The New Zealand Water & Wastes Association Waiora Aotearoa

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REGULARS

Cover Photo: John McCann from Watercare.

'Ka ora te wai, ka ora te whenua, ka ora nga tangata'
'If the water is healthy, the land is healthy, the people are healthy'

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.

Conferences provide welcome opportunities following lockdown

Kelvin Hill,
President, Water New Zealand

To steal a line from the Prime Minister – hasn't our team of five million done a great job in working together to avoid the devastating consequences of Covid-19? Staying home has certainly kept us safe in our part of the world.

So now it's time to celebrate our success by getting back together and sharing ideas face to face. That's why I'm urging you to make sure you don't miss our two key conferences – Stormwater and the Annual Conference and Expo.

Early in the lockdown, we optimistically decided to delay the Stormwater Conference till August (26-28) in the expectation we'd be able to have an event where people could meet and mingle face to face.

Our gamble has paid off and now I can promise a very warm welcome to those of you coming to the Stormwater Conference this year, in my home town of Tauranga.

We know that many organisations, and particularly councils, have been eyeing post-Covid budgets with a very focused lens. But it's important not to overlook the bigger picture and the tangible benefits that come from ensuring we share information and keep up to date with new developments.

This is a dynamic and fast-moving sector. These conferences play an important role in ensuring best practice across the industry. Both conferences are key sources of valuable information supporting sustainable business practice.

With that in mind, we're offering some very sharp deals this year because we know the funding difficulties that many will be facing over ensuring staff get to these conferences. While virtual conferences have their place, nothing can replace the experience of an in-person event.

We want you to come!

And if you've ever wondered what it might be like to stay in a motorhome, the Stormwater Conference is your chance to try it out – at prices unlikely to ever be seen again. Go to our website to find out more.

July and August are critical months for the Three Waters sector. The new Water Services Bill is set to be introduced into Parliament and that will no doubt spark plenty of discussion. We're very pleased that the Minister leading the Government's work around the reforms, Local Government and Associate Environment Minister, Nanaia Mahuta has agreed to speak at the Stormwater Conference and there will be a full day Taumata Arowai workshop the day before our Annual Conference and Expo gets underway.

Hamilton's Claudelands will again be the venue for our Annual Conference and Expo and we hope to see you there. Once again, it'll be a face to face event with thought leadership, workshops, numerous technical streams, industry awards and social opportunities.

I'd also like to take this opportunity to welcome our new CEO, Gillian Blythe, who comes to us after a long career in the electricity sector. She worked for more than 20 years at Meridian in senior leadership roles following her time at ECNZ where she was involved in electricity reforms of the late 1990s – early 2000s (see more on page 12).

Gillian's experience in infrastructure and reform will no doubt be a valuable asset for the water sector as we navigate through the new environment. You'll get a chance to meet her at our conferences.

Stay safe and I look forward to catching up with many of you at the Stormwater Conference in August and the Annual Conference and Expo in Hamilton in September.

And, in the meantime, a very happy Matariki.

Nga mihi nui, Kelvin

New Zero Carbon SIG identifies way forward

Water New Zealand's newest special interest group, Zero Carbon, is well underway with the setting up of a 12-member steering group.

The new special interest group was launched at an event in Auckland back in February attended by more than 80 members.

The key issues raised by the audience included: collaboration; education by sharing knowledge and training; sharing good news stories; consistency with carbon accounting and analyses; a need for reliable benchmarks to enable best focus; measuring performance based on local factors through consistent methods; community engagement; and building on the increasing awareness of the value of water.

Since then, the new steering group, which represents suppliers, contractors, clients and consultants, has identified the following areas of work for sub-groups:

- **Purpose** – a small group will aim to identify a clear purpose for this group.
- **Development** of a low carbon pathway for the NZ water industry.
- **Benchmarking** – link to the national performance review and how the carbon can be integrated.
- **Water New Zealand conference** – aim to hold a workshop as part of the next conference to focus on zero carbon.
- **Webinars** – identify two or more webinars per year to promote what this group is working on.
- **Covid benefits to carbon** – capture benefits and how we can identify carbon benefits out of the fiscal stimulus package.

If you would like to join or contribute to any of these work streams please contact katrina.guy@waternz.org.nz or jonathan.reed@beca.com.

Annual General Meeting

The Water New Zealand 2020 Annual General Meeting will take place from 7.30am on Thursday, 17 September 2020 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 Thursday, 13 August 2020.

Notice of meeting, agenda and any notices of motion will be sent to financial members by Thursday, 20 August 2020.

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

Congratulations to John McCann from Watercare

John won this year's annual Water New Zealand photo competition. This award-winning photo was taken at the wastewater outfall pipeline at Army Bay and features on the cover of this issue of the journal.

The photo shows the "pipe string" dotted with orange buoys and concrete ballast blocks being towed into the Tiri Channel in the Hauraki Gulf. And it's not the first award for the project. In September 2019 it won the international project of the year at a *No-dig* conference in Italy.

Once again, our photo competition certainly showcased the high level of creative skills and talent amongst our membership.

There were many outstanding photos and Water New Zealand would like to thank everyone who entered. And you'll likely see more of them in print over the coming months.

More water sector representation needed

Water New Zealand says new legislation aimed at speeding up consenting processes for infrastructure and development lacks adequate water sector representation.

In a submission on the Covid-19 Recovery (Fast-track Consenting) Bill, Water New Zealand says the legislation does not adequately allow for the integration of water infrastructure and services in considering proposed projects.

It says this omission could make it difficult for water service providers to ensure that water infrastructure is integrated into fast tracked projects.

While it supports the overall intent of the Bill, the association has asked for more consideration from the sector, including the new regulator, Taumata Arowai, be required in the assessment of any fast-track consents and projects.

Go to our website waternz.org.nz to see the full submission.

Water New Zealand Board Elections

Calls for nominations for election to the Board of Water New Zealand close on Wednesday, 29 July. 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.

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.

Sensible plan for freshwater clean up

Water New Zealand says the Government's Action for Healthy Waterways package provides a sensible and realistic way forward, and will result in much-needed improvements in freshwater quality.

In response to the May announcement, Acting CEO John Mackie said that it was vital that there was no further degradation of water quality and that there was a workable plan in place to ensure long term improvements in the state of our water.

He said the commitment of $700 million investment to improve water quality through riparian fencing, planting, wetland works and waterway improvements, would provide significant benefits for New Zealand.

"Freshwater quality has been in decline for many years and the specific improvement targets in this package provides for a long-term commitment to clean up our waterways.

"Using Te Mana o te Wai as the guiding principle clearly, and rightly, prioritises healthy water as the key priority."

He said he welcomed the directive to councils to manage E.coli levels in areas where people swim.

"Swimming in rivers, lakes and the sea has always been an integral part of New Zealand life and we need to take steps to ensure that all recreational waters are returned to a healthy state.

"While it is important to put controls on high risk farming practices and reduce the impact of nitrate on ground and drinking water, we need to continue to support the well-being of the productive sector.

"We have to acknowledge the effect of drought and Covid-19 on the country's economy and the role the primary sector will play in our recovery.

"That's why we support the move to delay the proposed national bottom line for dissolved inorganic nitrogen (DIN) at this stage to allow more time for a review of the environmental and economic implications."

Stormwater 2020 keynotes

Hon Nanaia Mahuta – leading our Three Water reforms

As a mother, and a constituent MP with 20 plus years' experience who has come from 'flax-root' politics, Nanaia remains connected to the aspirations of people from all walks of life.

As Minister for Local Government, she is leading the Government's Three Waters reforms.

She has supported policies and initiatives that build the capacity of communities, especially social service organisations, greater investment in education, employment and training opportunities particularly for young people, supported the continuation of the Treaty Settlement process and supported specific initiatives that lift the well-being and opportunities for young mums and those who are vulnerable and victims of abuse.

Nanaia is a member of Waikato-Tainui, Ngati Maniapoto and Ngati Manu and her parliamentary experience has enabled her to contribute to the collective aspirations of all New Zealanders.

Annette Lees – swimming outdoors

Annette Lees is the author of *'Swim: A Year of Swimming Outdoors In New Zealand'* (Potton and Burton). *'Swim'*, a social history and personal story of our old love of swimming in creeks, rivers, estuaries, lakes and the sea, was long-listed for the 2019 Ockham New Zealand book prize's Royal Society award for non-fiction.

Annette Lees directs Alternative Endings, a consulting business with a special focus on strategy, complex problem resolution, capability and sustainability of organisations along with design and evaluation of public good projects, programmes and issues.

Tom Schueler – defending small urban watersheds

Tom has 35 years of experience in practical aspects of stormwater and restoration practices to protect and restore urban watersheds.

Tom directs the Chesapeake Stormwater Network in the US, a non-profit devoted to training and engaging the public and private sectors to build more sustainable practices. The mission is to help restore the Chesapeake Bay, an estuary in the US states of Maryland and Virginia, and the thousands of miles of streams that drain this region's vast watershed.

Tom also serves as the stormwater coordinator for the EPA Chesapeake Bay Program, and has guided a dozen expert panels to consensus on the best practices to reduce runoff and pollutants from the urban sector. Some notable expert panels included stormwater retrofits, stream restoration, low impact development practices, urban nutrient management, street cleaning and floating treatment wetlands.

In his career, Tom has written more than 50 stormwater design manuals, research reports on best practices, and other watershed guidance documents. Tom founded the Center for Watershed Protection in 1992, and loves stream walks, floodplain reconnection, and building rain gardens.

Stormwater conference site visits

At this year's Stormwater conference there's an opportunity to choose from three uniquely different optional site visits – something to cater for everyone's interest and a great way to end the conference. Which one will you choose?

Friday, 28 August 2020

Site Visit One – Success Stories/Case Studies – Waterways
- Kopurererua Wetland Restoration
- Hairini wetlands
- Te Ara o Wairakei

Site Visit Two – Stormwater Management – Design Approach Innovation & Technology
- Tauranga flood hazard mapping and solutions
- Durham Street

Site Visit Three – Naturalising Te Ao Maori values
- Kaituna River Re-diversion

If you have already registered and would like to 'add' a site visit please contact us waternz@avenues.co.nz

Welcome to our new chief executive

For Water New Zealand's new CEO swapping a career in electricity for the water sector was easy. Gillian Blythe says it was the call of infrastructure and regulatory reform and now she is looking forward to the challenges of the coming sea change in the three waters delivery and the opportunity to make a real difference.

As a child growing up in Derbyshire in England, infrastructure has always been part of Gillian's consciousness, she says.

The daughter of a structural engineer, Gillian went on to study economics at London University and one of her first pieces of research was looking at the environmental impact of large hydro dams.

From there, she completed her master's in environmental economics and started working as an economic consultant in London, thinking about issues around climate change, ozone layers and so on.

But that was back in the 1990s and "no one was paying you to do environmental work" so a natural pathway led to consultancy work in the electricity sector.

This was a time when power generation and delivery was undergoing major reform internationally and Gillian found herself working on projects in places like Belarus and Uzbekistan.

Water New Zealand's new CEO, Gillian Blythe

"It's quite an eye-opener when you're sitting in someone's kitchen in Tashkent and you realise the gas hob has been left on. So, you suggest turning it off – after all, it's a bit dangerous, and the response is that matches are more expensive than gas."

This, she says, is an illustration of the importance of strong investment signals.

"People respond to signals and if you don't have information, or the right information, you can't possibly expect to get efficient and affordable outcomes."

It was electricity reforms that led Gillian even further afield from her then-home country down to New Zealand.

"In 1994 the Melbourne branch of the company I worked for, London Economics, had a contract with the New Zealand Government looking at restructuring the electricity sector, and creating a competitive market.

"Ultimately they got too much work, so sent an SOS to London for someone to get on the plane for seven weeks."

It was during her seven-week stint that ECNZ offered her a one year contract.

"I remember going back to England and being on holiday and thinking about the opportunity and deciding that I didn't want to get to 60 and wonder if I'd made a mistake."

So she came back to New Zealand where she was part of a team of people looking at creating the market rules for a deregulated market-driven electricity sector.

"We helped write the rule book, it was a fascinating project."

Then, on a personal level, came the decision about where to call home. By that stage Gillian had met her future husband, also working in the New Zealand electricity sector.

And after some consideration, the decision was made to live here permanently. Fast forward to today and Gillian now lives in one of Wellington's hillside suburbs with her husband and their two teenage boys.

Remember the Government reforms of the late 1990s that determined that ECNZ would be split into three separate state owned enterprises? Shortly after the decision to settle more permanently in New Zealand, Gillian was asked to work in the Electricity Reform Transition Unit.

"With a small group of colleagues, we worked on the split of ECNZ which formed Genesis, Meridian and Mighty River Power, which is now known as Mercury."

Looking back at that era, and despite the controversy around the split up and deregulation, Gillian believes the reforms were successful.

"You've now got a number of different parties investing in generation, you've got strong retail competition. All companies, including the larger players, have to lift their game because you've got new entrants coming in with new offerings, new innovations."

Gillian joined Meridian post the ECNZ split, where she established and led the regulatory team through a multitude of reforms. Gillian then took on the role of Head of Strategy at Meridian for six years before finishing at the end of 2019.

Clearly, grappling with the various parts to make up the big picture is what drives Gillian.

Not surprisingly, she is excited to be coming into the water sector at a time of transition and regulatory change.

"I see the significant infrastructure investment that's required in the New Zealand water sector and the opportunities for us all to make decisions that would have a positive difference for communities going forward.

"Water infrastructure is a long-term intergenerational investment and we need to make decisions that our grandchildren won't regret."

Reflecting on this must underpin our thinking, Gillian says and adding that the associstion's vision statement sums it up: *Ka ora te wai, ka ora te whenua, ka ora nga tangata – If the water is healthy, the land is healthy, the people are healthy.*

"We need to think about what climate change is going to mean for those parts of the country that will see an increase in flooding, or those regions with reduced rainfall that will have storage issues.

"Looking forward we will need to make sure that we have an appropriate balance of demand measures as well as infrastructure investments.

"The opportunity to make a difference is there for everybody in the sector. For Water New Zealand, I think some of this is around how we can help our members tell their infrastructure story so that their decisions are well supported by science, economics, and the regulatory environment.

"For instance, everybody in New Zealand knows someone impacted by the earthquakes, whether in Christchurch or Kaikoura. Likewise, most of us know someone affected by the Havelock North water contamination.

"And then there is Covid-19, and we all need to be thankful for the sterling work of our essential water workers who were out there keeping water and wastewater flowing during lockdown.

"These stories help humanise future investment needs, and why we need a regulatory regime for water."

As well as joining at a time when there are big changes ahead for the water sector, the next few months are a busy time in the events calendar. Gillian will have no sooner got her feet under the desk in Wellington when it will be time to head off to Tauranga for the Stormwater Conference in August (26-28) and then to Hamilton for the Annual Conference and Expo in September (16-18).

But she says the timing is good. Those first few months are for listening and learning.

"I'm looking forward to both conferences and to meeting as many members as I can and coming away with a better understanding about the sector and the issues that matter to members."

Integrated vision for the **health and well-being of our water**

By Hon Nanaia Mahuta, Minister of Local Government and Associate Minister for the Environment.

The last six months have been full of unexpected challenges in relation to the global pandemic. This is a health crisis of epic proportions and as we continue to respond to keep New Zealanders safe, we will inevitably gain resilience from understanding and responding to the opportunities ahead of us.

In the wake of our pandemic response to keep people safe, strengthen our health response and its terrible impacts on our economy we should not lose sight of the new possibilities that can reset and accelerate our trajectory to support whanau, communities, businesses, iwi, the environment and the way in which they work with central and local government in the recovery phase.

We need a vision that makes the most out of the crisis we are confronting to recover and become more resilient in what will be a very different world. A well-known saying amongst Maori says; Ki te kahore he whakakitenga ka ngaro te iwi – Without foresight or vision the people will be lost. This whakatauki (proverb), and the sentiment it carries, is more important now than ever. Importantly in relation to the environment and our water sector, its regulatory environment, its service delivery arrangements, and its infrastructure.

I have often outlined to the local government sector that the well-being and restoration of our waterbodies (rivers, streams, lakes and oceans) require a holistic and integrated approach.

Our Government sees addressing the state and fate of our water as critical. This is a commitment, not a nice-to-have. It is our vision that New Zealanders can turn on the tap for drinking water, are able to swim in our rivers, lakes and at the beach, or gather kai moana, without fear of getting sick due to poorly performing wastewater and stormwater networks.

The Government has endorsed Te Mana o te Wai as it connects to freshwater, land based activities, three waters infrastructure, urban water, and growth. We treasure fresh, clean water for our people's health, for our recreation, to protect our precious environment and productive economy. Water (wai) is a taonga (national treasure) that in many places is now under threat.

As Minister of Local Government and Associate Minister for the Environment, I have been working over the past three years with a range of senior ministers to address these challenges and reform our approach to water and its associated services.

The Three Waters Review, which I lead, began and ran alongside and in parallel with the Government Inquiry into Havelock North Drinking Water. Both followed the fatal 2016 campylobacter outbreak in that Hawke's Bay town that made about 5500 people sick, was responsible for up to four deaths, and left numerous other people with long-term ill-effects. The inquiry concluded that there had been systemic regulatory failure for drinking water and, among other things, recommended the creation of a dedicated regulator.

In September 2019, Cabinet made decisions about the creation of a new Water Services Regulator – called Taumata Arowai – to administer and enforce a new drinking water regulatory system, while contributing to improved environmental outcomes from wastewater and stormwater networks.

In December 2019, the Taumata Arowai – Water Services Regulator Bill was introduced to Parliament. This Bill establishes Taumata Arowai as a Crown agent. It is expected to be passed in the next month.

At the same time, Cabinet noted that a second complementary Bill, the Water Services Bill, would be prepared to give effect to our decisions on reforming the drinking water regulatory framework, and some of Taumata Arowai's wastewater and stormwater functions.

This Bill is well under way and expected to be enacted sometime towards the middle of next year. There will be opportunities for feedback on its provisions as it makes its way through the legislative process, and I would encourage this.

Taumata Arowai's primary focus is the regulation of drinking water, but it is also expected to play an important role in national-level oversight and system-wide performance monitoring of wastewater and stormwater networks.

Regional councils will remain the regulator under the Resource Management Act, but Taumata Arowai will provide advice on management and environmental performance of the networks, as well as national-level leadership, communication and co-ordination.

It will have a role in providing information to central and local government, and the wider three waters sector with respect to the development, operation and effectiveness of standards, regulations and statutory requirements for these same networks; and a similar oversight role in relation to compliance.

Taumata Arowai will also have an important responsibility in promoting public understanding of the environmental performance of water networks. Maori perspectives on water will be fundamental. I am aware that the establishment of Taumata Arowai is progressing at pace and engagement with the water sector is now underway.

As Associate Minister for the Environment, I have been closely involved in the Essential Freshwater work programme, particularly as it relates to urban water. Over the past two years, the Urban Water Working Group, an independent group of practitioners, has also developed recommendations on how we can restore and enhance Te Mana o te Wai in urban areas.

In late 2018 they published Nga Wai Manga – the Urban Water Principles, which sets out a vision for urban water in Aotearoa. The Group has recently finalised a report with further recommendations on implementing Nga Wai Manga, recommendations that will require us to rethink how we manage stormwater. I will be considering how Government can best respond to these recommendations.

Hon Nanaia Mahuta, Minister of Local Government

Officials are also continuing to develop guidance for local authorities on how they can improve stormwater outcomes through policy, planning and delivering infrastructure, and consenting stormwater discharges.

The scope for this guidance was informed by advice provided by the Urban Water Working Group and is intended to work alongside the recently announced Action for healthy waterways package of freshwater reforms.

The impact of Covid-19 on the economy has been stated that where we can, we should look bravely to the future. For water services and infrastructure, the crisis has reinvigorated the possibilities for working across sectors on transformational reform.

Our partnership with local government on reform is live and evolving, but the aims remain constant: to envisage a future where all communities have access to safe, affordable and sustainable drinking water, and where our wastewater and stormwater networks are fit for purpose, contributing to good environmental outcomes, and helping to restore the mana (health) of our precious taonga (national treasure) that is our water – this is a commitment to an intergenerational vision for our mokopuna (grandchildren).

Working together to build capability and capacity for stormwater

By James Reddish, Chair of the Water New Zealand Stormwater Group and the Training and Education Subcommittee.

Skills shortages are adversely affecting the country's productivity and well-being. In the stormwater sector this has widespread flow-on effects across all four well-beings, because stormwater plays such a leading role in human and environmental health and the economic value and value-add of its built and natural infrastructure.

Inadequate education and training costs our communities. Most of this cost is borne by public and private infrastructure agencies, from lack of investment in green (water sensitive) infrastructure, to associated poor social, cultural and environmental outcomes, and the cost of repair and rework.

A lack of stormwater-related training is a problem with far-reaching and expensive consequences.

This has been validated through the surveys and workshops the Stormwater Group held in 2017 and 2018 that demonstrated an unmet need for training in the industry. These capability and capacity challenges exist now, and the industry cannot wait for the Government's vocational reform to be completed before taking action.

A national approach to stormwater training

In response to this challenge, Water New Zealand provided funding to the Stormwater Group to engage the Environment and Sustainability Strategic Training Institute's Clare Feeney, to help develop an Education, Training and Sector Development Plan.

This plan represents a significant development in the organisation of industry training. It is a critical first step to enable a wide range of stakeholders and organisations to agree on an overall approach and work collaboratively to achieve national capability and capacity needs.

The plan sets out a framework to classify stormwater training based on the water sensitive development cycle. This allows a strategic overview of the entire stormwater and related sectors and their different but interdependent professional and vocational skills, while providing a structure to help people search for the training they want.

The plan also represents a 'go to' guide if you are considering developing training. It includes needs, drivers, target audiences, and currently known providers, as well as guidance on prioritising training needs, how to develop and evaluate training, and a three-year executable plan with next steps for our industry.

Training development is happening now

Some training initiatives are already under way. Auckland Council has brought the US National Green Infrastructure Certification Programme (NGICP) into New Zealand, responding to issues it is having with vested assets. This training targets those working in the construction, operation and maintenance of green infrastructure – one of the critical gaps identified in the *Stormwater Industry Training Framework*.

And while a lot of training is available, much is yet to be developed, and the people with the skills to develop and deliver the training are within or known to the stormwater profession and the many associated professions.

Delivering the plan, we need YOU!

Following development of the draft plan, the Stormwater Group Committee is engaging with organisations to raise awareness, gain feedback, understand training priorities, and promote partnership and collaboration in the development and delivery of training.

To date this has included organisations such as IPWEA and Engineering New Zealand; regional groups such as the Canterbury Stormwater Forum and Bay of Plenty Freshwater Forum; large asset operators such as Auckland Council and Wellington Water; tertiary education institutes such as the University of Canterbury and Unitec; and central government departments such as the Ministry for the Environment.

The feedback to date has been positive. Our contacts recognise and value the structure of 'a plan' and have expressed a strong desire to collaborate and contribute to addressing industry needs.

The Education, Training and Sector Development Plan is a draft document and can be downloaded from the Water New Zealand Stormwater Group webpage www.waternz.org.nz/StormWater.

It will remain a live document, recognising the rapid change not just in stormwater management, but in training needs and delivery post-pandemic.

The Stormwater Group Committee welcomes feedback on the plan. There are gaps and opportunities to refine.

We need expertise to help address those and to take forward and then own the plan. Expertise does not just come from stormwater technical experts, but those with expertise from outside of our technical disciplines – particularly those in education and training, but also linking with specialists in other fields critical to successful stormwater management, such as cultural input, asset management, landscape architecture, ecology, and leadership, amongst others.

Most importantly, an industry-driven plan needs your input. How can your organisation contribute to building our national stormwater capability and capacity?

If you want to contribute, please get in touch with Mumtaz Parker, Water New Zealand Training Development Manager, at training@waternz.org.nz.

Matariki atua ka eke mai i te rangi e roa, E whangainga iho ki te mata o te tau e roa e.
Divine Matariki come forth from the far-off heaven, bestow the first fruits of the year upon us.

Celebrating Matariki

By Troy Brockbank (Te Rarawa, Ngati Hine, Ngapuhi), Water New Zealand Board Member and Kaitohutohu Matua Taiao (WSP).

Matariki is an important event for Aotearoa that occurs every year and signals the start of the Maori new year. Matariki is a time to celebrate, reflect, and acknowledge the past, present and future.

Matariki (Pleaides) is a cluster of stars that are visible in the night sky at a specific time of the year. It disappears from our view in Haratua (April/May) and reappears on the dawn horizon in Pipiri (June/July). This year Matariki is anticipated to rise between the 13-16th July 2020.

Acknowledging and celebrating Matariki has in recent years become an increasingly important part of our national conversation and identity. It has significantly aided in the naturalisation of Te Ao Maori (Maori worldviews) in communities and ignited all cultures to celebrate their relationship with the whenua (land). Now we are talking about the possibility of Matariki becoming a national holiday.

Interestingly there are three stars (Waipuna-a-rangi, Waiti, Waita) within the Matariki star cluster that have a deep connection with water.

Waipuna-a-rangi is associated with precipitation and is often referred to as 'the spring in the sky'. Rain from Waipuna-a-rangi helps nourish the whenua (land) and waterbodies and is returned through evaporation. Using the water cycle, Waipuna-a-rangi reminds us that manaaki (generosity) that is given to others, will eventually be returned.

Waiti is associated with fresh waterbodies and all the food sources, and creatures within. Rainfall from Waipuna-a-rangi nourishes the freshwater bodies watched by Waiti, before they flow out to the saltwater bodies of Waita.

This flow of freshwater from the upper catchment to the sea reminds us of our connection to water, and to each other.

Waita is associated with oceans and salt waterbodies and all the food sources, and creatures within. It receives the flow of water from the freshwater bodies on the land. It reminds us that our actions upstream can have adverse effects downstream.

Matariki is also a time to celebrate new life, remember those who've passed and to plan for the future. So, to all our members and those in the wider water sector, we hope you are enjoying this time to welcome new arrivals and reflect on the life and contribution of those who have passed this year.

Matariki hunga, Matariki ahunga nui.
Matariki has many admirers, Matariki brings us together.

Honouring a water service professional

It was refreshing to see a scientist acknowledged in this year's Queen's Birthday Honours list, but for Jan Gregor, her career has simply been about ensuring communities have access to safe drinking water and sanitation. By **Mary Searle Bell.**

Jan Gregor was named in this year's Queen's Birthday Honours List for her service to water safety and public health.

"It's humbling that someone thought enough of me to nominate me," she told *Water*, although she's still in the dark as to who that someone – or group of 'someones' – is.

Jan has dedicated many years of her career to supporting isolated and disadvantaged communities to gain access to safe and resilient drinking water and sanitation. Those she works with at SPC (The Pacific Community) were delighted to hear she had been awarded the honour of Officer of the New Zealand Order of Merit:

"Fantastic Jan," reads an email, "just wanted to send you a message from your Pacific family to recognise the citation and offer our heartfelt congratulations which is so very much deserved!"

"I know they recognise arts, culture and the rest but your award for the sciences and in particular water quality in public health has a special place in our hearts in the Pacific for sure."

The evolution of Jan's career is different to many in the industry. It has unfolded organically, as Jan learned what really mattered to her and what she could contribute.

"I purposefully allowed myself to drift," she says. "I was never locked in one direction. If I tried something and I didn't like it or it didn't have value, I changed."

At school she wasn't one for the arts so got into science instead, purely by chance.

"I wasn't particularly academically-minded. I was far more interested in sports and physical, outdoorsy stuff. But I went to university, because that's what you did in 1980."

Jan completed a BSc Honours degree then moved onto a Ph.D. in chemistry, "around metals like lead and zinc binding to natural organic matter – understanding how soils form and how metals move through soil."

By coincidence, this is how the coagulation method of water treatment works, using metals to remove natural organic matter from drinking water.

"I didn't know that at the time," she says, laughing.

Following her doctorate, Jan thought she would carry on in academia, so headed to the chemistry department of Leeds University in the UK for two years.

"I couldn't possibly remember details of what I was studying – it had something to do with dentistry chemistry. But it did hone my research skills.

"I spent a lot of time sightseeing and playing sports.

"There's far more to life than work."

In 1989 Jan returned to New Zealand to post doctorate work with the then DSIR in its water section. She, along with Chris Nokes, was one of the scientists in the labs undertaking drinking water testing for the Ministry of Health.

"We checked that the equipment was working, made sure quality assurance was in place and prepared reports," she says.

"I learned about the composition of water from the chemistry side.

"I then wanted to learn more about drinking water and the process of treating it. I was particularly interested in coagulation. So, I got in touch with some water suppliers and got to know the water community better, providing consultancy services."

In 1992, DSIR became ESR, and a few years later, the Ministry of Health wanted more than analytical services, and Jan became heavily involved in drinking water advisory services.

"We morphed as a group within the organisation to one providing advice rather than routine monitoring and lab work.

"From 1995 to 2007 was really quite an exciting time. New Zealand drinking water was taking its next steps forward. We were evolving into what we have now – a national safe drinking water programme based on public health risk management."

Jan says she had a particular interest in smaller communities that don't have the funding or the professionals

"It's humbling that someone thought enough of me to nominate me."

Jan Gregor

that their bigger counterparts have, and she wanted to make sure that what was coming out of the Ministry of Health would work for them too.

This led to her interest in Pacific communities which have similar issues.

"I'm far more interested in the difference we can make rather than the science.

"I like to look at the bigger picture – the issues, what needs to be done to fix this, what disciplines need to come together – and then have knowledgeable minds working on the details."

Jan served on the board of what was then NZWWA for many years, becoming Water New Zealand's first female president in 2002.

"The association has been an important part of my professional life for a long time, connecting me not only to the Pacific but to some very wonderful and inspiring members."

It was through hosting the Pacific Water and Wastewater Association board in the late 1990s she got to know a number of senior Pacific utility operators, and contributed to the regional wastewater policy they were pulling together.

She provided advice and was later formally asked to participate in regional initiatives as a technical advisor to the New Zealand Aid Programme. This led to further work with the New Zealand Aid Programme and the World Health Organization.

"This is where I learned I could be a useful facilitator. I listen, and help other people share. Then I assist them through the sense-making process and help them come up with a collective voice.

"I don't provide a lot of detailed technical input into my work in the Pacific, but having the knowledge means I can find connections between what people say and help stretch the conversations.

"My role as facilitator is simply to get them talking to each other about things that matter to them."

It's something she's clearly very good at, given her latest accolade.

While her work in the Pacific will continue, Jan is currently looking at how ESR can support the newly-forming regulated drinking water system.

"There are many different water suppliers of various sizes and meeting the new regulations will likely be a challenge for smaller communities," she says.

"There will be some interesting times to come.

"That's the great thing about working in water and wastewater – there's always something happening."

Real-time data freshwater solution

The Drinkable Rivers campaign aims to "give rivers a voice to be heard" and Bex De Prospo from the group explains how using real time data to check contaminants will help mobilise communities into taking a stand for their rivers.

Christchurch-based freshwater initiative, Drinkable Rivers, is a movement led by real-time data, which focuses on the stories of New Zealand's waterways by giving our rivers a rhetorical 'voice'.

The initiative was founded by Christchurch entrepreneur and environmental advocate, Michael Mayell, as his "moonshot" vision of something aspirational that he wants to achieve in his lifetime. He thought targets aiming for "swimmable" rivers are not good enough and our failure to reach those targets in the majority of our waterways reflects that.

So, in 2018 Michael partnered with co-founder Anake Goodall and his 'philanthropic' organisation, Seed the Change (He Kakano Hapai) to sponsor the development and build a prototype for a real-time water quality measuring device.

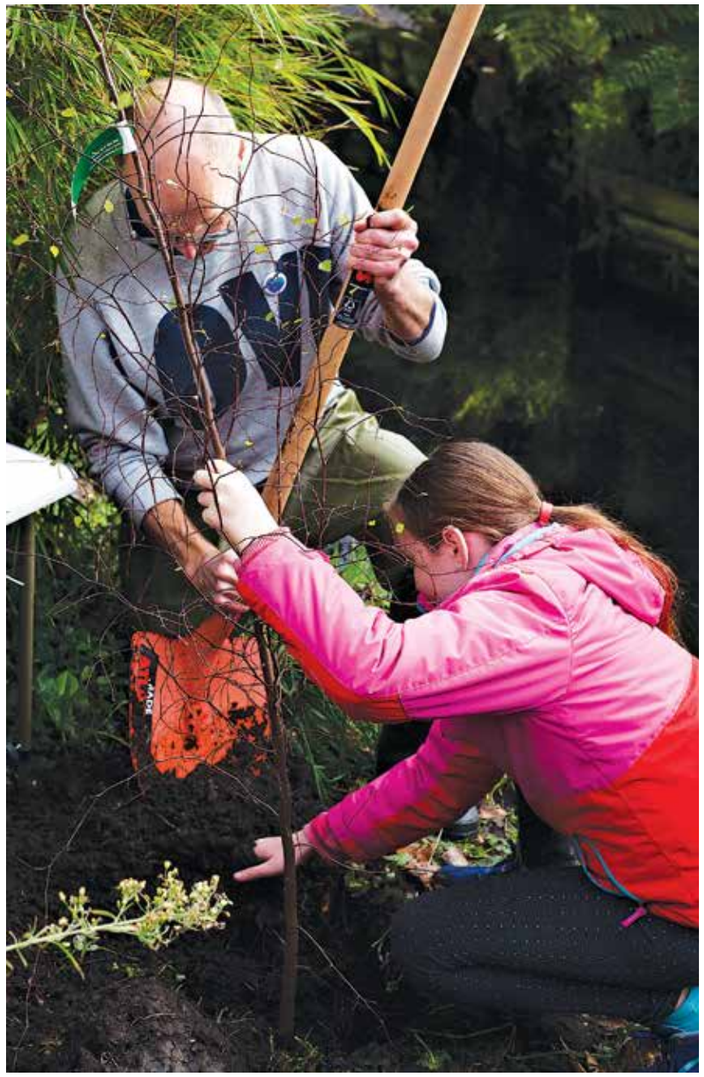
Dubbed Oracle 1 the first device was sited at the head of the Avon (Otakaro) River in June of 2019 and 'Drinkable Rivers' work began in earnest.

For the last year, Oracle 1 has been taking half-hourly measurements of a range of key indicators (pH, nitrates, temperature, dissolved oxygen, conductivity, and reduction-oxidation potential) that are supplemented by manual water tests for culture-tested contaminants such as E.coli. The real-time results are displayed on a dashboard on drinkablerivers.nz with the full data history available for open-source download and research.

The goal for Drinkable Rivers is to create a network of these devices throughout the Avon River, the Heathcote River and beyond. As this network takes shape, we can begin to add value to existing data from local and regional governments by supplementing existing periodic trend data with real-time information about when, and where, contaminants are being introduced.

We see the 'story' around Canterbury freshwater as incomplete with a huge focus (both in narrative and in funding) on agricultural activity as a single source of contamination, even though we know that the issues facing our urban rivers are considerably more complex.

We hope to lessen what we perceive as a rural/urban divide and unite Cantabrians on one side, fighting together for the health of our waterways.



Left: Drinkable Rivers founder Michael Mayell with a student river guardian. Above: Michael with Oracle 1, the prototype for a real-time water quality measuring device.

We see real-time data and the stories it tells us as the key to unlocking engagement with stakeholders and empowering urban residents to be an active part of the freshwater solution.

It is the goal of the Drinkable Rivers team to create a self-sustaining movement which can be adopted by community groups, citizen advocates, businesses and schools throughout Christchurch and, ultimately, the whole of our country.

Much of the work in our early stages of operation has been in actively developing a framework to support this, and we are working to mobilise communities by actively fostering a collaborative approach with established water advocacy groups, as well as local businesses and schools.

Most notably, we have partnered with Villa Maria College, located just a short walk from Oracle 1. We are working with its staff throughout this year to develop a pilot guardian (kaitiakitanga) programme to allow students to act as guardians for this first stretch of the Avon River.

The data taken by Oracle 1 and the supplementary manual water tests are being woven into the long-term Villa Maria curriculum with outputs including ongoing water reports and physical maintenance of the riparian zone around Oracle 1.

We are working with a skilled ecologist to create a landscape plan for this area which, with the support of local government, will aid in re-establishing the indigenous plant species that were once at the head of the river, in turn helping to restore the natural biodiversity of the area.

It is our expectation that future devices would also be linked with schools or established community groups who wish to work on remediation efforts in their local area. And we see huge benefits of this approach, both in tangible improvements to water quality and in support for the many water advocacy groups who have been working tirelessly in this space for many years.

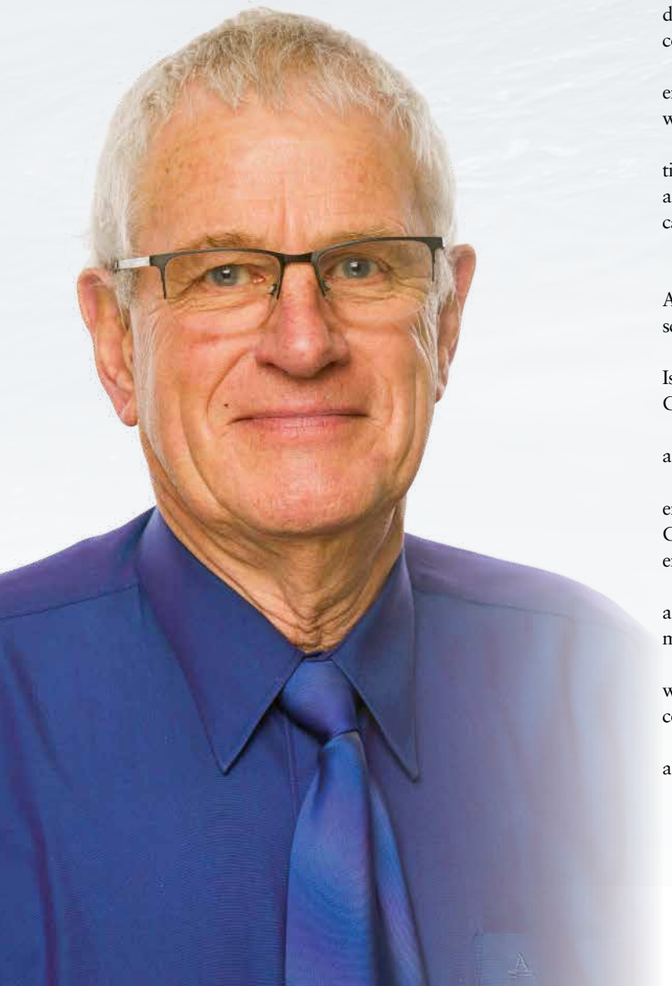
With access to real-time data in their area, they can start to see the positive impacts of their work and plan future activities strategically with the information that the data is telling them.

Like the rest of our country and the world, the impacts of the pandemic have forced the Drinkable Rivers team to assess and re-prioritise the months ahead, but our goals for 2020 and beyond remain clear: to get more sensors in more rivers, continue to upgrade and fine-tune our data dashboard, and continue to mobilise and energise the freshwater space with an expanding network of collaborators. Could you be one of them?

We'd love to hear from you! Visit drinkablerivers.nz or www.facebook.com/drinkablerivers or send us a message at yes@drinkablerivers.nz.

The Kiwi pipe whisperer

John Black's passion for and expert knowledge of pipelines, saw him dubbed 'the pipe whisperer'. Now, after 57 years listening to pipes, he has retired, however the obsession remains. BY **MARY SEARLE BELL**



John Black: After 25 years with Opus and WSP, John retired in April this year.

Water magazine spoke to John as he was in the midst of unpacking after moving from Leithfield Beach in North Canterbury to his new home in Rangiora. While still surrounded by boxes, he was more than happy to stop and chat about his career and love of pipes.

Like all engineers, from childhood, John was interested in seeing how things worked. However, at high school, his principal discouraged him from going to university, saying he was 'not considered suitable for a professional career'.

So, with not a lot of scope for jobs in Balclutha, he started an engineering cadetship in 1963 with the Otago Catchment Board, working on the Lower Clutha Flood Control Scheme.

"This flood control scheme was a pretty major exercise at the time," he says. "I worked under various engineers and surveyors and saw quite a bit of construction of flood banks and drainage canals and the like.

"It was good, interesting work."

In 1974, John joined engineering consulting firm Hay and Associates as an assistant engineer, working on rural water supply schemes in south and west Otago.

Ten years later, he uprooted his family and moved to the North Island after securing a job as a senior engineer at the Upper Hutt City Council.

"I wanted to become a registered engineer, so I had a chat with an old boss who said, 'there's a job up here if you want it'," he says.

Obtaining his registration in 1990, John worked as the water engineer for Upper Hutt City for five years before joining Works Consultancy Services (now WSP), as a senior environmental engineer.

"I gradually worked my way up, becoming principal engineer and eventually, and I have no idea why, 'technical principal pipeline materials' within the Opus International group."

But that fancy title was an Opus official one. He prefers 'the pipe whisperer', which came about at an event in Queenstown when a contractor introduced him to a colleague as such.

"I don't actually talk to pipes, but they talk to me. They tell me a lot."

Solving pipe issues is what John does best. Over the years he has developed pipe condition assessment techniques for different types of pipes.

"I learned pipes are not all the same, and there are issues with all pipe materials."

In 1995 he joined three joint AS/NZS standards committees for various plastic pipes, and says he found it very interesting.

"At the standards committees I found a whole bunch of people who were also keen on pipes, which was most enjoyable, and it broadened my network of contacts – of specialists in particular."

John's passion is PVC pipe: "It's always been my thing. I've taken a real interest in it from my Balclutha days."

However, one of John's standout achievements concerns asbestos cement pipes. He was the first in the world to use CT scanners to look at the condition of these pipes.

"We take a sample of the pipe out and wrap it in plastic to ensure it is hygienic and then put it through the CT scanner at the hospital.

"The scanner creates cross sections through the pipe at regular intervals – either images or video – which we can use to assess the condition and/or deterioration of the pipe."

He hit upon this idea in 2007 after bringing back a sample of a pipe from Queensland, Australia, "as you do when you're a pipe whisperer".

"I declared it, and it was double-wrapped in plastic," he's quick to say. "Although I didn't tell them it was a piece of sewer pipe."

As the piece of pipe went through the customs scanner at Christchurch Airport, John was blown away by the detail he could see in the pipe on the screen.

"I said to the operator, 'can you slow that down?'."

Back at work, John had a colleague whose wife worked at St Georges Hospital in Christchurch and through her they were granted access to the CT scanner there to look at pipes.

"We got such good results that it's now a WSP standard way to assess the condition of pipes.

"Other techniques involve cutting the pipe, which creates dust and other health problems."

Following the Canterbury earthquakes, John did considerable work assessing pipe condition, as well as providing advice on earthquake-resilient materials. His paper, titled *Earthquake Damage to Buried Pipelines*, was awarded best technical paper at the 2012 Ingenium conference in Rotorua.

His expertise on all things pipe saw him invited to speak at two pre-conference workshops at the ASCE pipelines conference in Texas in 2013, an experience that he enjoyed hugely, and which widened his circle of pipe-enthusiast contacts even further.

After 25 years with Opus and WSP, John retired in April this year. But although he's no longer officially working, John is still curious about pipes, and has, in the last few years, developed a keen interest in polyethylene pipes, "polyethylene welding in particular," he enthuses.

"There are a few issues that are not well known."

It seems, retired or not, that John is still listening to pipes.

Solutions for Freshwater

in the Upper Clutha

The recently-released Shaping our Future Upper Clutha Freshwater Taskforce Report 2019 has highlighted the challenges and solutions faced by the community in efforts to restore the health of the region's natural waters.

By Jim Bohm, Chairman, Upper Clutha Freshwater Taskforce for Shaping our Future.

The Shaping our Future Upper Clutha Freshwater Taskforce Report 2019 highlights an urgent need for the development of an active water management process informed by research that ensures a well-founded understanding of catchment processes and ecosystems in the Upper Clutha and involves the community.

Pointing to the vital role that freshwater plays in the economic, environmental and social well-being of the district, the report notes that the iconic alpine lakes and their catchment areas are integral to the identity of the Upper Clutha district and that they are highly valued by residents and visitors alike.

Shaping our Future's Taskforce was formed in response to increasing concerns in the community about the deterioration of waters that were once widely regarded as "pristine" and "pure".

Rapid resident and visitor population growth has led to significant urban development and rural land use changes, resulting in loss of habitat and wetlands alongside an increased demand for water. Added to these problems are incursions of new invasive species didymo, lagarosiphon and lindavia intermedia or "lake snow" along with the spread of existing pest species in the natural eco-systems and the widespread loss of native fish species in the district.

Vision for the future

At the heart of the report is a simple long-term vision of "Pure water, Healthy ecosystems and Engaged community". Pure water is defined as naturally drinkable, swimmable, renewable and healthy, available, valued and used wisely with little or no impact on the natural state of our waterways.

A healthy ecosystem is diverse and species-rich with good biological functionality, with no species life-cycle impairment, no new invasive organisms and one in which existing invasive species are managed or eradicated. In an engaged community, people and groups in the community, landowners, business owners and agencies are educated and aware of the importance and value of our waterways, with everyone understanding the issues and working together to secure the best possible outcomes for future generations.

The Taskforce recommends steps towards achieving the community's 2050 vision for freshwater. Minimising the impacts of growth and development on freshwater is a key priority, which is a complex, multifaceted challenge. It is hoped

Fishing in Lake Hawea. The iconic alpine lakes and their catchment areas are integral to the identity of the Upper Clutha district and they are highly valued by residents and visitors alike.

that the recommendations and vision, when implemented, will achieve the following:

- Establish a formal leadership and management process in which Otago Regional Council (ORC), Queenstown Lakes District Council (QLDC) and other agencies with responsibility for freshwater will work alongside the community to effectively manage freshwater. The recommendations encompass water-sensitive urban design and rural land use policies to strengthen the legislation applying to subdivisions to eliminate adverse environmental impacts of development, reduce impacts of growth on freshwater systems and to prioritise sustainable land use. The report recommends adopting global best practices based on science to inform policy, planning and management decisions.
- Protect and enhance eco-systems by establishing and implementing an Upper Clutha Freshwater Management Plan. This should include the re-generation, protection and expansion of wetlands, continuation of appropriate riparian planting, reduced contamination from urban and rural activities, understanding of the effects of climate change, establishment of a habitat renewal and re-stocking programme for native aquatic species plus an evaluation of hydro lake levels and their impacts on our eco-systems.
- Develop effective ways to influence community culture and awareness through an education and awareness programme. This will aim to provide positive, strong and effective guidance to our businesses, residents and visitors in how they care for our water.
- Establish a well-funded research and monitoring system for the lakes, rivers and catchments of the Upper Clutha that is robust and nationally comparable. A modelling process will be used to identify and understand all freshwater systems within the catchment area including the impacts of changing land use across both rural and urban landscapes and the effects of climate change.

Upper Clutha Taskforce vision

Led by the community

Shaping our Future uses the Natural Step process of sustainable strategic development to deliver a community driven vision and recommendations towards achieving the vision. It helps these visions come to fruition by working in partnership with regulators and community organisations. In the Upper Clutha district the Taskforce included representatives from groups with an active involvement in preserving and enhancing the ecosystems and water in the Upper Clutha catchments.

The work on the Upper Clutha Water report began in in April 2018 when Shaping our Future held public forums in Wanaka and Queenstown on the topic of freshwater. The Upper Clutha Freshwater Taskforce was formed with volunteers from a range of backgrounds who share a commitment to a sustainable and healthy future for freshwater. The Taskforce has sought input from experts in different areas.

The report aimed to complement and support the values and actions recommended in the Kai Tahu Ki Otago water perspective, Te Runanga O Ngai Tahu Freshwater Policy and Ngai Tahu Climate Change Strategy. The Taskforce was guided by the knowledge of Richie Hewitt who was appointed to the Taskforce by the Hokonui Runanga of Ngai Tahu.

A second public water forum was held in late 2019 in which the Upper Clutha community reflected on the Taskforce's findings and recommendations before the report was finalised.

Hopes for the future

The Taskforce has reasons to be optimistic that the report's recommendations will be heeded in the right places, particularly as Shaping our Future has an established track record of promoting the recommendations in its reports and ensuring that they are read and understood by the relevant official bodies.

Calum MacLeod, the Deputy Mayor of QLDC, participated in the Taskforce, making practical suggestions for ensuring that QLDC will take appropriate note of the report. Parts of the Taskforce report are now to be found in the Community Catchment Plan developed by WAI Wanaka together with ORC, QLDC, Te Kakano Aotearoa Trust and Catchments Otago.

WAI Wanaka is also setting up the Alpine Lakes Research and Education Trust (ALREC) to provide a research base for the natural environment and freshwater. ALREC is set to open its doors later this year and become a "living laboratory", a manifestation of the vision of the late ORC councillor Dr Maggie Lawton and Dr Marc Schallenberg from the University of Otago to secure long-term ecosystem health by promoting collaboration and communication between researchers, regulators, educators and local communities.

ALREC is one of a number of community initiatives that will be important for promoting the ideas and recommendations found in the Upper Clutha Water Taskforce report, in particular the need for more and better research and monitoring of our waters and for community education that is effective in influencing and improving the ways people care for water in the Upper Clutha catchment.

Detecting Covid-19
in wastewater

ESR is looking at testing wastewater to help detect the presence of Covid-19 in a community. Funded with assistance from the MBIE Covid-19 Innovation Fund, this research aims to find out whether this method could be used to help identify previously unrecognised cases.

By Brent Gilpin, ESR Science Leader, Health & Environment; Rob Lake, Manager Risk Assessment & Social Systems; Joanne Kingsbury, Senior Scientist, Health & Environment; and Joanne Hewitt, Head of ESR's Environmental Virology Laboratory.

The coronavirus SARS-CoV-2 emerged in late 2019 and by March 2020 a global pandemic was declared by the WHO.

There has been an explosion of interest and activity in the potential of testing for SARS-CoV-2 in wastewater as one of the surveillance tools for the presence and/or prevalence of infection in the community.

Following initial reports by researchers including from the Netherlands, USA and Australia, testing of wastewater for SARS-CoV-2 has been undertaken in at least 14 countries including New Zealand.

Wastewater-based epidemiology uses the fact that, for those of us connected to reticulated sewerage networks, everything from our toilets, showers, kitchen sinks and washing machines ends up in our wastewater. People infected can excrete it in faeces, saliva or nasal secretions that can end up in sewers.

Current wisdom suggests that there is a very low risk of sewage containing significant levels of infective virus, but the genomic material (RNA) of the virus provides a signal that can indicate the presence of infected people in a community.

As people can excrete virus within a few days of infection, this signal in the sewage may occur before people experience disease symptoms and before they even think about getting tested for the virus. This potential early warning, and large-scale surveillance possibility are two of the attractions of wastewater testing.

There are four key steps in wastewater testing – sample collection, virus concentration of wastewater, viral RNA extraction and the detection of any SARS-CoV-2 RNA present.

For detection in wastewater, currently the only practical approach is to detect the genomic RNA from the virus.

Reverse transcription polymerase chain reaction (RT-PCR) is a laboratory technique combining reverse transcription of RNA into DNA (in this context called complementary DNA or cDNA) and amplification of specific DNA targets using polymerase chain reaction (PCR). It is primarily used to measure the presence of a specific RNA. Quantifying the amount of the RNA is achieved by monitoring the amplification reaction using fluorescence dyes, most commonly using real-time quantitative PCR (qPCR).

Several RT-qPCR tests have been developed based on different target regions of the SARS-CoV-2 genome.

Most commonly used targets include the regions within the nucleocapsid phosphoprotein (N) gene (three different fragments of this gene, N1, N2 and N3, have been used) and the envelope (E) gene. While RT-qPCR assays can be very sensitive and specific they don't indicate whether any virus detected is infectious.

There are two primary scenarios for the use of wastewater testing for SARS-CoV-2 surveillance.

The first scenario is to monitor changes in prevalence when the virus is already established in an area. This is the situation in most other countries. Provided a standardised approach to sampling and analysis is developed, and the levels of community infection are above detection limits, sewage-based surveillance of relative changes in the levels of SARS-CoV-2 in an area can be implemented.

Calibration of the measured levels of virus in sewage against confirmed Covid-19 cases, hospitalisations, deaths and estimated cases needs to be undertaken. The second scenario is that in the absence of Covid-19 in an area, wastewater testing can be used to detect unrecognised SARS-CoV-2 infections. This will hopefully be the primary application for this technology in New Zealand.

In the context of wastewater-based epidemiology, two important considerations for wastewater testing are the impact and likelihood of false positive and false negative results.

False positive results

A false positive result occurs when testing of a sewage sample indicates the presence of the SARS-CoV-2 virus when in fact there are no infected people in the area tested. There are a number of types of false positive results.

The first type of false positive result occurs in the testing laboratory when a positive PCR result is due to cross-contamination between samples, either from laboratory controls or from other sources such as the sampler.

Although the very low levels of SARS-CoV-2 RNA in sewage make detection more challenging than in clinical testing (where levels of virus are higher), these sources of false positive results can be controlled using well validated methods and careful attention to sampling and testing protocols.

The second type of false positive is when a positive result is found in a sewage sample, but this arises from a person who is no longer infectious but who is still shedding viral RNA. There have been reports of people testing PCR positive for the virus many weeks after they were first infected, and for longer than they excrete infectious virus.

If viral RNA from these people is detected in sewage, it may falsely indicate a problem.

The third type of false positive relates to detection of SARS-CoV-2 in sewage, but when that virus is excreted from people who were only passing through, or don't actually live in the area where the sewage was collected. This could result in public health response incorrectly targeted to an area where there aren't any Covid-19 cases, or may warrant expansion of the area for investigation.

False negative results

A false negative result occurs when there are infected people in an area but sewage testing doesn't detect them.

Every method has an inherent detection limit, but this is dependent on a number of factors. For wastewater analysis this includes: (1) how much sewage is collected and the equivalent volume tested (and which fractions; liquid versus solid) following concentration and viral RNA extraction; (2) assuming we don't test all of the sewage (which is of course impossible), how frequently we sample that sewage; (3) degradation rates of SARS-CoV-2 and its RNA, leading to reductions in detectable viral RNA, in sewage.

This will be affected by not only the inherent characteristics of the virus, but other components of sewage and factors such as temperature and time; (4) losses of virus and/or viral RNA during concentration and RNA extraction steps; and (5) the sensitivity and specificity of the detection method.

The first two components are essentially sampling considerations that are influenced by the degree of mixing and homogeneity in the sewage, as well as the input levels from people shedding the virus. For New Zealand we would ideally like to be able to detect even one infected person.

While wastewater testing is undoubtedly going to be useful, there are a number of knowledge gaps that need to be understood. The key question is how does the detection of SARS-CoV-2 RNA in wastewater correspond to the prevalence of infection in the community?

Key components of this question include: The amount

of SARS-CoV-2 excreted by infected people each day; differences between excretion of SARS-CoV-2 and detection of viral RNA from faeces, saliva, and nasal secretions; excretion differences between asymptomatic, pre-symptomatic, symptomatic and post-symptomatic people; the effect of diarrhoea as a symptom on the amount/concentration excreted; time course of excretion during infection; and the persistence of SARS-CoV-2 and viral RNA in excretions and in sewage.

There are also data gaps in relation to testing methodology, including: When to sample, and where to sample; volumes of sewage needing to be concentrated to provide a PCR signal; detection limit of the assays; and the best laboratory procedures, including SARS-CoV-2 concentration, removal of PCR inhibitors, and most suitable genome PCR targets.

Finding solutions

The MBIE-funded Covid-19 Innovation Fund is supporting work to answer these questions and to establish robust and reliable tools for the detection of SARS-CoV-2 in sewage, that can be used to identify any unrecognised Covid-19 cases in New Zealand.

There are four workstreams in this project:

- Establishment of robust laboratory analysis methodology. This will include extraction methods for sewage, sludge and aerosols, a range of detection methods, process controls and normalisation standards, and testing of stored samples.
- Design and implementation of wastewater sampling methodologies that can be applied in a range of situations. This will include consideration of sampling of sewage, sludge and aerosols, techniques for different locations from treatment plants, to pumping stations, to aeroplanes; optimal sampling frequencies and locations.
- Appropriate surveillance strategies in large and small communities. This also includes consideration of social licence issues, development of predictive modelling, and back calculations, and incorporation into overall surveillance response.
- Investigations of the infectivity and persistence of SARS-CoV-2 in sewage and the effectiveness of wastewater treatment processes.

This project has already had strong support from the water and waste community in New Zealand, and we look forward to working even more closely with this sector over the next 12 months as we develop and implement wastewater testing for SARS-CoV-2 as part of this country's surveillance strategy.

Megan Woods and Dr Joanne Hewitt at her visit to ESR to announce funding for CRIs

Talking with a future leader

Named as an emerging leader at the 2019 Association of Consulting Engineers, Chris Maguire has certainly shown his talent for leadership in his career thus far. BY **MARY SEARLE BELL.**

Still only in his mid-30s, Chris Maguire recently became the group manager water, upper North Island, for Stantec, having taken care of the company's South Island water group for the previous four years.

His approach to management is to focus on people rather than projects – encouraging professional development within his teams and figuring out what drives individuals. He is also very focused on the community – it's the reason he chose engineering; he considers it a service to society.

This desire to be involved in public service, coupled with a bent for science and maths and a natural curiosity about the world around him, made engineering the ideal career path.

"My father was an electrical engineer by trade before becoming a telecoms engineer. He was always fixing things," he says of his childhood in Ireland.

Emerging leader at the 2019 Association of Consulting Engineers, Chris Maguire

"I was an inquisitive child, and academic too. At school I was good at maths and physics and understanding how things work.

"My high school had an excellent STEM (Science Technology Engineering and Maths) programme. As teenagers we were given the opportunity to help Visteon, a car parts company, to solve a problem they were having with a part that failed – it was around the car throttle and whether it was airtight. Our solution had to be replicable and take less than a minute to test.

"It was a real-world problem and we were working with not only our teachers but Visteon engineers, and we then had to present our solution at a trade show.

"Engaging in this way lead me down the engineering route."

After high school, Chris started an electrical engineering degree but soon discovered it wasn't for him.

"My physics teacher wanted me to go down the electronics route, I don't think he knew what civil engineering was, but I didn't enjoy it. After one year of study I went out and found out about different engineering disciplines, shadowing a variety of engineers: maintenance, civil, water, to find the one I liked best."

Consequently, he switched to a degree in civil engineering.

"I had an amazing time working for the Hamilton City Council under MWH."

That being said, civil engineering is a broad discipline in itself, and Chris discovered he wasn't keen on structures and he didn't like roads. He reminisces about how, as a child, he loved to spend his time at the beach building dams and canals – redirecting the sea water. These memories and his lifelong love of the environment determined that water was the industry for him.

As part of his studies, he had a one-year placement with McAdam Design. There he was involved in wastewater treatment plant upgrades, assessing their capacity, surveying, and writing full reports, even though he was just an intern.

Showing his leadership skills early on, Chris started an engineering society while at university.

"I got sponsorship funds from local businesses and we went on a trip to Poland to visit dam sites and mines. It was great to get out and engage with industry."

His involvement with IAESTE (International Association for the Exchange of Students for Technical Expertise) then took him to Poland for three months; this time with multinational construction firm Skanska. He spent his time doing site surveys and quantity surveying for buildings that were being upgraded to telecoms buildings. Along with gaining valuable technical experience, Chris also learnt Polish, and more.

"There were about 100 students from all around the world with me in Lodz. All the engineering and technical people lived together, and this really helped me connect with different personalities and cultures."

In his final year at university, Chris studied the ecological footprint of a wastewater treatment plant, looking at the land area required for the plant against the area of forest required to sequester the carbon to determine whether a larger or smaller treatment plant is better for the environment.

It will come as no surprise then to find Chris chose to join MWH (acquired by Stantec in 2016) because of its sustainability focus. There, his first boss was one Gabriella Giuffre.

"Gabriella was very disciplined and firm but the best design engineer I've come across," he says.

"She was gruff, but that was good for a young engineer.

"I also worked with other great engineers. My project manager Paul Preece took me under his wing and taught me how to manage projects and clients. A lot of my work was wastewater treatment plant upgrades; very similar to my internship, and I really, really loved it."

Then the global financial crisis hit, and the world went into recession.

"No new projects were released from 2008 and there were lots of redundancies in 2009. I said to my boss, 'send me somewhere else in the world and I'll ride it out'."

After the request went out on the MWH network, James Yearsley from Hamilton put up his hand to take Chris for two years, so he made the move to New Zealand.

"James was very engaging and very positive. He told me I could achieve what I want.

"I had an amazing time working for the Hamilton City Council under MWH."

Following the earthquakes in Canterbury, Chris got the opportunity to move to Christchurch with the Stronger Christchurch Infrastructure Rebuild Team (SCIRT), where he spent two years working with fiberglass pipelines and helping rebuild the city's underground network of pipes.

At this time, he also became the chair of Engineering NZ's Canterbury branch, providing education on the earthquakes and engaging with the community.

After two years, Chris wanted something different so "jumped back into consultancy" with MWH and took on a team manager's role.

"Then, aged 31, I decided to put my hat into the ring for the role of group manager for the South Island. The average age of the team was reaching 50," he says.

While he started off with 25 staff, the merging of three different business units soon swelled this group, hitting 65 clients and 100 staff in February this year.

"I set things up so the team can run independently. I'm always travelling for work as well as spending five weeks in Ireland a year, so I work remotely a lot."

A few months ago, he moved to the upper North Island group manager role where he now has just three main clients and 35 staff.

"It's a different mix of people and places," he says, comparing it to his previous role. On top of this the pandemic is changing the world and economic crisis looms.

"It's an interesting place to be in. It's not the first time we've gone through a downturn like this, and it will have a big impact on health and mental well-being.

"However, it is an opportunity to change the way we do things. We can gain efficiencies, gain intelligence and gain innovation.

"While they're tough, good things can come out of recessions."

Innovative waste pipe relining under lockdown

In December 2019 two wastewater sludge pipelines buried in a tunnel deep under Mt Albert in Wellington both collapsed and over five million litres of sewage spilt into the city's harbour.

The Mt Albert tunnel takes all the wastewater from Island Bay – about 100 litres per second.

The discharge points are near Whairepo lagoon on the Wellington waterfront so the pipe collapse prevented Wellingtonians from swimming in the harbour over the summer break.

The network was built in 1998 as a dual-pipe system and it was considered "highly unusual" for both pipes to fail. The council suspected an installation fault back in 1998 that was meant to last at least 80 years. Repair options included repairing the pipelines or bypassing the pipes altogether. Reportedly, a similar repair, also due to a defect in the concrete in which the pipes are embedded, was carried out in 2013 and took five weeks to complete.

The waste pipes carried sewage treatment by-product between Moa Point and a plant near the Wellington landfill. As a temporary arrangement a parade of trucks ferried the waste by road along Wellington's south coast, costing around $100,000 a day. The race was on to find a solution, which was to be compounded by the five-week L4 Lockdown on Match 25.

In late January 2020 Wellington Water engaged engineering firm Stantec to identify repair options and manage the project (see separate story page 41).

The option to re-line the pipes was considered the best with a temporary backup plan if the liner bid failed. This plan included putting a pump station on Town Belt land at the Berhampore Golf Course, meaning the sludge trucks would not be needed.

A third option, if the first and second options failed, involved fastening a temporary pipeline to the roof of the sewerage tunnel. A fourth and final option was to continue trucking.

Brian Perry Civil was engaged as the lead contractor to undertake the enabling works and to manage the other contractors working on site.

A long list of lining options was quickly whittled down to a shortlist of two for relining the existing pipes. From the shortlist SaniTube, from German Amex Sanivar was selected, based on value for money and a quick installation. New Zealand agent and installer Hadlee & Brunton undertook the project work.

A team of five German specialists were flown out on a charter plane, spending a quarantine period in Auckland, before arriving in Wellington to start work, initially patching the leak before inserting a polyester liner through the pipe.

Despite the additional challenge of the global pandemic both pipes were successfully relined by the end of May, thanks to a multi-disciplinary team who delivered an innovative repair. Work is now underway to plan a repair with a temporary bypass, as well as a long-term fix.

Worksite at Moa Point. Photo courtesy of Prime Pump.

Celebrating Achievement

Water New Zealand 2020 awards nominations

Water New Zealand's annual awards showcase outstanding achievements of individuals and organisations.

The Water New Zealand awards, presented at the Downer Conference Gala Dinner, are a great opportunity to show support for the professionalism and efforts of our members and their contribution to both the industry and community.

There's still time to get your entries or nominations in before the closing date, Friday, 7 August. Visit www.waternz.org.nz/awards for criteria and entry information. The awards are presented at the Downer Conference Gala Dinner.

Key awards include:

Ron Hicks Memorial Award sponsored by Mott MacDonald – for an article or paper solving or clarifying sewage treatment or water pollution problems in New Zealand

Beca Young Water Professional Award – recognises a young professional's exceptional achievements in the early stages of a career in the water industry

Poster of the Year – provides an avenue for presentation of knowledge or experiences through the medium of display posters at the Water New Zealand Conference & Expo.

Water New Zealand Trainee of the Year – recognises hard work, aptitude and a keen desire to advance a career in the water industry.

Health and Safety Award – acknowledges and rewards a corporate entity or individual who has developed an innovation which eliminates or minimises a health or safety risk in the water industry.

Pipeline & Civil Project Award – provides recognition of excellence not only in the delivery of a project but also the contribution of various parties to the final outcome.

5S SocietyYWP Conference Attendance Prize – Nominations are also being sought to provide two young water professionals the opportunity to attend the Water New Zealand Conference & Expo to broaden their knowledge and gain greater appreciation of the water industry.

Other awards presented at the conference include:

Hynds Paper of the Year – for the best technical paper presented at the Water New Zealand Conference & Expo

Hynds Presentation of the Year – judged in conjunction with the paper of the year, recognises the best presentation of a technical paper

TRILITY Young Author of the Year – complements the Paper of the Year Award encouraging the participation of young authors at the Water New Zealand Conference & Expo

IXOM Operations prize – for best practice with strong operations flavour

www.waternzconference.org.nz

Moa Point – a lesson in digital learnings

Some infrastructure projects are so critical to the health and well-being of the local community, that they cannot wait including one of the largest diameter wastewater rehabilitation projects ever seen here. Story written and supplied by Interflow.

Located under the coastal streets of Moa Point is one of Wellington's most critical sewer pipelines that manages wastewater for over 200,000 residents.

It was discovered that the pipeline had been compromised by severe corrosion and was at risk of collapsing. The corrosion had reached, and in places penetrated, the steel reinforcement of the pipeline, posing a health threat.

Wellington Water publicly tendered the works seeking an innovative yet cost-effective solution that would minimise disruption to local residents.

The project was awarded to water infrastructure specialist, Interflow and the Moa Point wastewater rehabilitation project would become the largest diameter sewer pipeline renewal project to take place in this country.

Compromised by pandemic

The contract was awarded in late February to reline 260 metres of Wellington's main sewer and work started in April when work crews had to adapt to the L4 lockdown.

With New Zealand's lockdown regulations among some of the strictest in the world, Interflow's project engineer, Saadia Ali, describes some of the challenges the crews had to overcome to keep the project on schedule.

"The expectation that colleagues from Australia would fly out and provide support was no longer a reality and required us to employ some unconventional approaches," she says.

Interflow's New Zealand crew had been expecting assistance from their Australian counterparts through training from experienced Rotaloc staff. Once travel restrictions were put in place by both the Australian and New Zealand governments, in a business first, Interflow's crews turned to virtual channels to bridge the training gap.

Tenacity and determination shine

"The solution was a remote Rotaloc training session held via video link to bring our team up to speed on the patented technology's application and operations."

The Rotaloc installation of a new liner into the pipe provides a durable, long-term solution that will protect Wellington's wastewater Interceptor from corrosion and support the needs of the community for at least another 50 years.

"Our team worked extremely hard to overcome the challenges faced due to the pandemic. We were working away from our families in an 'Interflow bubble' and had to rethink the way we collaborated with our customers, contractors, and the broader community," says Saadia.

The works have now been completed thanks to virtual training and collaboration that took place during this project, a method that is now incorporated into the company's New Zealand team.

Pandemic sludge pipeline rescue

Stantec was involved in the story of the Mt Albert sludge pipeline repair in Wellington during the pandemic. Article supplied by the Stantec Wellington team.

Back in mid-January two pipelines that take wastewater treatment sludge from Moa Point Treatment Plant to the Wellington City Council's Southern Landfill burst.

Wellington Water put CCTV through the pipes located in the base of the Mt Albert wastewater tunnel on 28 January to understand the extent of the fault and find solutions for a long-term repair. The faults were located at approximately 170 and 230 metres from the Adelaide Road chamber, one of two entries to the tunnel.

The bursts happened only a matter of weeks after a wastewater tunnel collapsed underneath Willis and Dixon streets in central Wellington on 20 December 2019. As in that case, the first priority was to minimise the risk of public and environmental harm.

An urgent fix was required to prevent sludge outflow entering the Cook Strait. A trucking operation was used to convey sludge from the plant to the landfill and, at 120 trips daily, the 'turd taxis' as local residents came to call them were the most significant cost at close to $100,000 a day which included personnel, pump hire and varied other costs.

Plus, carrying over a million litres of sludge a day and working on a 24-hour rotation, the trucks' constant noise and smell was a real disruption for residents on Wellington's South Coast, along with the ongoing safety and environmental risks of trucking waste.

Fortunately, quick work from the team made up of Wellington Water, consulting engineer Stantec, and contractors Brian Perry Civil and Hadlee & Brunton meant no wastewater or sludge was discharged to the environment as a result of the pipe failure, and the risks associated with the trucking operation.

As time ticked on and the trucking costs increased day by day the team worked around the clock to get the pipelines operational again.

The repair posed a major technical challenge because the bursts occurred deep beneath Mt Albert in a live wastewater tunnel, therefore it wasn't practical to excavate the pipes. The safest option, and most likely to be successful to reinstate the pipework, was to use specialised liners – a circular polyester weave extruded with thermoplastic polyethylene which didn't require curing in place.

Manufactured by German company AMEX Sanivar, the liners and their installation team had to fly to Wellington at a most inconvenient time: during the global pandemic and our Level Four Lockdown.

"Wellington Water pulled out all the stops to get AMEX down to New Zealand," explains Project Manager Josh Wright from Stantec.

"They worked closely with the Council and Government to secure special permission for the group of five German experts to come and help us fix this network.

"We had the liners delivered separately. Waiting for both to turn up at the same time would have resulted in a three-week delay for sludge pipeline operation, created construction sequencing challenges, and increased sludge trucking costs."

The first liner arrived in Wellington on 3 May and was joined by the German installers who had been in a two-week quarantine in Auckland.

The Wellington team together with the lining experts completed a patch repair and installation of approximately 1.8 kilometres of liner between 6 and 9 May in the first of the two sludge pipeline repairs.

The patch was remotely installed 170 metres into the pipeline to stop infiltration and to cover any sharp edges, protecting the liner during installation and operation. The liner was then folded, taped and pulled through the existing pipeline with a winch and inflated to break the tape.

By 23 May, the first pipeline was handed over to the operator and the sludge trucks could be taken off the road.

In case of a delay on both liners Stantec had a 'Plan B'. This involved patching the bursts, which had to be done anyway, then pumping the sludge from Moa Point to Berhampore through the existing 5.5 kilometre section of pipeline to a set of temporary pumps that would be installed at Berhampore Golf Course.

From there the sludge would be pumped to the dewatering plant at the Southern Landfill until the arrival and installation of the liners.

Although this would have been an additional cost, Plan B endeavoured to reduce the trucking costs by getting them off the road at the same time as the original plan. If Plan B had been operational for three weeks before lining it was expected to cost around $1.1 million (setup and operation), however, that would have saved $2.1 million in trucking costs and thereby a net saving of $1 million over a three-week period.

Should the delays have extended beyond those hypothetical three weeks, the operational costs for the pump were 30 percent of the trucking costs, so further savings would have been realised.

The second liner arrived on 20 May into Wellington and the second pipeline is expected to be operational in July following the construction of additional chambers outside the tunnel.

Further project requirements include repairs to the base of the tunnel. This will involve person entry and requires a significant amount of planning and risk mitigation before the repairs can be carried out.

A video about the pipeline repair can be found on the Wellington Water website.

Some 928 million litres of sewage
and a bath towel or two

Article written and supplied by Prime Pump.

Six eight-inch BBA BA180 pumps from Prime Pump were pressed into service for the recent Moa Point sewer interceptor over-pump.

It was a significant job with each pump running for around 215 hours, pumping a combined total of 928 million litres of wastewater.

Prime Pump has over 200 Netherlands-designed and manufactured BBA pumps working in civil, construction and mining around New Zealand on river diversions, dewatering, flood response, and sewer bypasses.

In addition to the already significant pressures of environmental sensitivity and intense public scrutiny was the need to protect the crew working in the pipe. To these challenges was added the pandemic lockdown.

Interflow NZ was awarded the contract to rehabilitate both the 1800 diameter and 1350 diameter intercepting sewer pipes by re-lining. Interflow engaged Wellington contractor EN Ramsbottom to carry out the over-pump portion of the work. For both companies it was one of the largest projects of its kind that they had handled.

The repairs had been fast-tracked after internal corrosion of the pipes had been discovered during an inspection of a section of interceptor, which is the main pipe carrying Wellington's wastewater to Moa Point for treatment.

And before the interceptor could be relined it had to be over-pumped. This diverted the wastewater flowing through the interceptor allowing access for the relining machine and its crew.

The discovery of the issue with the interceptor had come soon after two high-profile pipe failures in other areas of Wellington, so public interest was elevated, as Moa Point is located right next to Lyall Bay, and near the Wellington International Airport and a residential area.


Moa Point transfer station

Michelle Hoffmann, the contract manager at EN Ramsbottom says there were a lot of stakeholders. Among them; the airport, active community groups, the public and the wastewater treatment plant itself.

"It was important that it went well," she iterates.

An additional complication was a relative lack of detail for the all-important flow calculations. The Moa Point wastewater treatment plant has a flow metre, but it only gives a two-hour average. Ricardo Holt, Hire Operations and civil contracting manager for Prime Pump says flow can change massively in that time window.

The solution was night operation, which meant flows were more consistent and more easily predicted and daytime peaks (lunchtimes, for example) could be factored out.

The auto prime dewatering and sewer bypass pumps selected for the job are capable of pumping a combined 1000 to 1200 litres a second giving the contractors and companies involved confidence in their ability to achieve the task.

This was backed-up by test pumping which showed conclusively that the over-pump was within the BA180s' capabilities. As lines had not been cleaned for some time, early unexpected challenges included a work boot and a bath towel, which the pumps dealt with effectively.

The pumps had to have environmental credentials too. Fully-bunded, they are well-proven working around waterways, with no possibility of fuel or oil entering the water flow. Ricardo says their cost-effectiveness was another consideration.

"The pumps' efficiency reduces fuel consumption to a minimum. They run on significantly less than comparable pumps."

The already tight timing for the over-pump was further impacted by the coronavirus pandemic. Prime Pump put the pumps on one of the last Cook Strait ferry crossings from the South Island to the North Island, just before lockdown. Similarly, some staff, (like many other essential workers) left their children with grandparents in order to be available on-site for the duration of the project.

Managing a supply chain through a pandemic

Ensuring a continuing supply of essential water treatment chemicals during the lockdown was critical to the health of communities. Ixom's Business manager Water, Graeme Colquhoun explains how the company activated a pandemic plan originally conceived back in 2003 in response to the SARS outbreak.

Crises create opportunity and the pandemic not only offered Ixom an opportunity to tightly manage supply chains to the benefit of many New Zealand industries, including water, but also gave us a greater opportunity to partner with our customers and stakeholders in our response.

Our pandemic plans and consistent engagement placed Ixom in a strong position in which to ride the Covid-19 storm. And, as a result, we were able to continue to deliver essential chemicals for safe drinking water, dairy and agriculture, learning and adapting along the way, with increased resilience for the next crisis that comes along.

Ixom's chemicals, technologies and services are used by water authorities nationwide for the supply of safe drinking water and the treatment of wastewater. Our company employs approximately 200 people in New Zealand and produces more than 30,000 tonnes of water treatment chemicals each year for the local market.

As a supplier to many essential services, it was vital that the company was able to maintain its operations and support its customers throughout lockdown and beyond.

In 2003, Ixom was able to start preparedness for pandemics as the SARS outbreak gave the company pause to reflect, 'what if?'. It drove us to consider the strengths and weaknesses of our operations. As a result, we collaborated with key customers to develop and implement a comprehensive pandemic plan in the wake of SARS, which would activate in the event of a global outbreak.

The pandemic plan forms part of our overall crisis management plan, which is routinely tested by senior management. The plan details how Ixom would continue to operate and maintain supply in the midst of a global outbreak. It considers access to raw materials, maintaining production plants and transport operations, technology required to work remotely, maintaining business support functions, and most importantly, ensuring health and well=being of our people and our customers. The plan is also cognisant of the importance of monitoring evolving situations offshore with a view to responding quickly should the need arise.

While SARS prompted the creation of the pandemic plan, the swine flu outbreak in 2009 triggered the first activation of the plan. And, although the swine flu pandemic did not impact local operations significantly, the experience led to a focus on the plan's implementation. Robust plans are essential but when the time comes, plans must be able to be activated, and quite possibly not with the resources you typically have.

So, when a new coronavirus emerged in late 2019, and human-to-human transmission started occurring outside of its place of origin, Ixom activated its pandemic plan for the second time. In January, our focus was on information gathering, and monitoring developments and the spread of Covid-19 in other parts of the world. It triggered us to increase our stock levels for critical products and raw materials to avoid disruption to supply.

In February, the challenges were generally with international supply chains as China went into lockdown and lead times for a range of products globally started to increase and shipping schedules started to change.

As the pandemic made its way to New Zealand, our plan required us to expand our focus to more local risk mitigation activities such as additional hygiene measures, for example, moving to contactless deliveries to customers, removing non-core people from operational sites, and wide-scale testing of our work-from-home capability.

Key take outs

- Have a plan
- Consider how you'll implement it, trial and test
- Assume you'll have reduced resources and plan for it
- Be prepared to change the plan
- Collaborate and communicate
- Review the process after the event to capture the learnings

Thinking on our feet

We shifted into a higher gear when the Government announced an immediate move to Alert Level 3, followed by a 48-hour warning for Alert Level 4.

We had already identified remote work and contingency operating plans as a component of our crisis management plan and, as a result, already had good IT infrastructure and remote work systems in place. The pandemic simply required us to scale up. During this time our customers wanted assurances that we had everything under control; we had to quickly navigate a new, official process to determine which businesses were essential and could continue to operate; and we had a team of 200 who not only needed support to keep our business running, but had to set themselves up for a totally new way of living and working. It was a period of intense change for everyone, so we placed communications at the heart of each activity.

Much like everyone, we had to quickly become very comfortable with video conferencing, which helped us to stay connected and retain our culture. We had daily meetings with people to check on their well-being and agree on our focus. This included regular contact with our customers and suppliers to ensure our activities aligned with their plans.

Collaboration

One of the key learnings from this period is that while there were constantly new issues to deal with and new rules to follow, our customers and other industry suppliers were all in the same situation, grappling with the same questions.

A significant number of protocols had to be generated at pace in line with the new rules being developed by the Government. The catch phrase of the day, "we're all in this together", rang very true, the upside of which was collaboration. We worked closely and agilely with customers to share ideas, sense check our thinking and learn how other people had already solved the same problems. For example, we workshopped how we would manage a return to our offices in Alert Level 2.

During lockdown, Water NZ invited Ixom to be part of a Department of Internal Affairs essential services workstream – Water: critical supplies. In just two meetings, we provided sufficient information to assure them that the water treatment chemical supply chain was secure for our customers and we were left to continue, allowing them to focus on other core activities.

Now we are back to Alert Level 1 working face to face with our teams, our customers and our suppliers.

We're taking a deep breath and slowly exhaling, proud of our resilience and preparedness, and look ahead to an extensive debrief to understand what worked well and what we could improve on. And, importantly, we won't do that in isolation. We will involve a broad range of people, including customers, suppliers and other industry leaders in true partnership.

Asset infrastructure modelling through IDS planning

Asset infrastructure expert Dr Theuns Henning talks about the application of dTIMS in our asset management after it was given some very practical Kiwi twists.

Our most valuable public assets are usually cited as airports, commercial forestry, or public land holdings, but at the heart of every city or town lies vital infrastructure assets such as roading and water without which, other public assets would have no value.

And how infrastructure assets are managed at a local and regional level affects us all.

Owned by The Institute of Public Works Engineering Australasia (IPWEA), *Infrastructure Decision Support* (IDS) was created to provide industry leadership in the development, advocacy, and implementation of evidence-based decision making for infrastructure.

A charity organisation, IDS began in the mid-1990s when Kiwi practitioners were looking for a tool to help them forecast asset maintenance needs. After evaluating programmes around the world, the Canadian software company Deighton Associates' dTIMS tool was chosen – its flexibility made it ideal for what the industry needed and it meant that IDS could ensure access of the tool for local authorities across the country regardless of their size.

Dr Thenus Henning, CEO of IDS, moved here from South Africa in 1998 to help with the implementation of the programme and continues to manage the organisation and oversee dTIMS national distribution and implementation.

A passion for assets management

Dr Henning says he lives and breathes all things 'asset management'. It's a passion he has dedicated his life to, and something that makes him sought after internationally as a speaker and consultant.

He also holds many other roles within the civil engineering industry and is a Transportation Engineering Group leader and Senior Lecturer at the University of Auckland. He is also a founding member of the Climate Adaptation Platform, specialising in asset management, performance monitoring, climate adaptation, performance-based contracts and benchmarking.

Theuns believes making informed, evidence-based decisions lies at the heart of good asset management at both senior management and technical level.

"From the moment assets are constructed they deteriorate, whether they are roads or water pipes, and regular maintenance is required to keep the asset at the best level to provide the best performance for the public.

"The decision on when to maintain and how much money to invest is a difficult one, especially if you have thousands of kilometres of roads or pipes to look after."

How we measure up

After working with many large organisations around the world, Theuns says that asset management as a topic area has always been strong here, but being a small economy, our infrastructure maintenance is done on a shoestring budget. We have learnt to keep our assets in decent condition so that deterioration does not result in total asset replacement, he says.

"Kiwis are very good at writing about 'best practice' and adopting sophisticated technical tools. In particular, dTIMS, which is used all over the world but given some very practical Kiwi twists when applied here.

"We don't just assume something works because it gives us numbers. We have validated and tested the tools here to make sure the outcomes delivered are relevant to New Zealand."

Compared to the rest of the world, he also believes we are better at the connection between the technical tool and practice, or "what happens on the road itself".

Collaboration is an important factor when it comes to developing solutions that benefit not just individual organisations but the entire industry.

"We always undertake technical developments in collaboration with both the industry; consultants, contractors and councils, the end-users and the asset owner."

Water infrastructure management

An important asset area where dTIMS has been involved is in water infrastructure management.

"The biggest danger with a water pipe network is that it's underground, nobody sees it and for most of its long life, we don't worry about it.

"In New Zealand, given the age of our water pipe network, the network has deteriorated to a point where it is starting to break frequently. Replacement costs escalate and the network becomes exceedingly difficult to maintain."

The IDS water analysis tool (potable water) has been another collaboration for the good of the industry. Dunedin City Council sponsored the IDS water tool development after Acting CEO at Water New Zealand, John Mackie, saw the need and the value for a decision-making tool as part of their planning process.

"The actual development work was done as a partnership between IDS and WSP where Philip McFarlane was the key contact. Philip has an account

"Deighton assisted us from Canada with coding the system into dTIMS. Half of the work was done by the Council whose team contributed significantly to the development of this model," says Theuns.

The benefits of a tool like this for senior executive managers is that they can see how much they should invest into their pipe network to prevent its decay to a level where it will cost them an enormous amount of money to fix, he adds.

"The water model can also be used to explore the ratio between required investment levels to retain a network's current value versus how this will impact the pockets of ratepayers."

The IDS water network analysis tool has been used at three councils to date: by the Dunedin City Council; in the testing of Hastings District Council's network; and, more recently, with the Central Otago District Council.

Unsealed roads modelling

Another example where the dTIMS programme is applied, and of interest to councils happens to be one of his favourite subjects – unsealed roads and the application of the IDS Unsealed Roads Modelling Tool that has been developed in conjunction with Central Otago District Council (CODC) and others.

Unsealed roads are incredibly important to our economy, he stresses with around 80 percent of our economic trips starting on unsealed roads, especially in the primary sector. Not surprisingly, little is known about this in the public domain because people don't typically drive on them, says Theuns, and yet they make up 40 percent of our roading networks.

"Gravel road management systems around the world have been unsuccessful because they are data-hungry and not useful in the answers they provide.

"There was a need for a reliable tool here because it was difficult to substantiate the investment levels councils put into their unsealed roads.

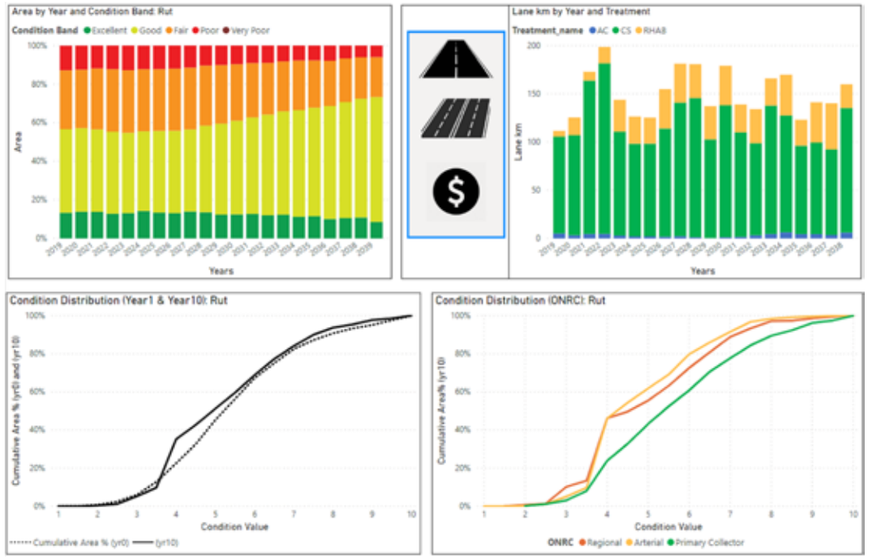
"They didn't know whether the level of service was appropriate for their communities and could never prove that the investment made into their network was actually at the right level. The tool we developed for unsealed roads addresses those specific needs."

The CODC was looking for a way to address questions it had about its unsealed roads network. CODC Infrastructure Services Executive manager Julie Muir had been championing the research underpinning the Unsealed Roads Performance Framework for the past seven years.

Top: Gravel Road, photo courtesy of David Wall. Above: The IDS water analysis tool (potable water) has been another collaboration for the good of the industry.

The council had spent a considerable amount of effort to understand the issues on their network and they wanted to capture that work and future proof it. They had experienced considerable benefits using the dTIMS system on their sealed roads network and were looking to adopt the same advanced decision-making on their unsealed roads network.

"Ultimately the perfect situation is an unsealed road network delivering 100 percent customer satisfaction and no complaints from road users," says CODC Asset engineer Andy Bartlett.



The IDS Executive Dashboard designed to help improve communication and transparency by delivering complex, technical analysis in a simple, graphical format.

"The aim is to deliver a system that might not be perfect but remains affordable and fit-for-purpose within key constraints: staffing levels, grader availability, gravel pit access, aggregate quality, and limited budgets.

"The key outcome for us was a modelled representation of Central Otago's unsealed road network that reflects 'on the ground' situations.

"This allows us to take a tactical and strategic approach to unsealed road asset management that simply has not been possible for us before."

Theuns says the development of the IDS Unsealed Roads tool was very much a typical collaborative project.

"The entire sector has contributed to what is in the system. We had help from research students at the University of Auckland with the technical solution, CODC who sponsored its development, while Hassan Salarpour from Beca assisted with the coding of the system along with Deighton in Canada."

The tool addresses questions at both operational and strategic levels.

"Operationally councils want to have things like roading maintenance and renewal programmes, and at a strategic level they want to look at their typical cashflow over a financial year or for at least three years," says Theuns.

"The tool provides the ability to run different investment scenarios and vary investments per year and see what the outcome of that will be in terms of the condition of the roads and potentially the public complaints if the road is not performing as it should be."

The Executive Dashboard translates complex into simple

Theuns believes that in asset management there is often a disconnect between technical and non-technical decision-makers.

He says IDS identified and addressed this gap with its recently launched Executive Dashboard that is specifically designed to help improve communication and transparency by delivering complex, technical analysis in a simple, graphical format.

"I think we live in a day and age when reading of reports is becoming obsolete. People don't want to read through a 50-page technical report.

"Our dashboard is pitched at executives. It clearly communicates the investment story, why we do things, why we need money to be spent in the given time frames and shows different investment scenarios along with the consequences."

The dashboard was recently used successfully for investment analysis for the New Zealand Transport Agency (NZTA).

"The investment information used by the NZTA and its contractors nationwide includes both the type of treatments and predicts the future condition of the road network. Information is displayed in either a graph or map format."

Looking ahead for the industry

The post-pandemic recovery is expected to bring significant investment into infrastructure.

"Maintenance and renewal works have a greater job creation opportunity and should, therefore, be balanced appropriately with new construction works," says Theuns.

Following that phase, the Government will go into a mode of 'now we've got to repay all of our debt', it will start reducing investment into infrastructure, he says.

"At which point, making smart asset planning investment decisions will become more critical than ever and that's where IDS's planning tools can benefit our industry."

To learn more, visit www.ids.org.nz.

In the wake of COVID-19 and with Taumata Arowai almost fledged, uncertainty around the economy and funding of new infrastructure, we need to remember the issues that we had been grappling with pre-lock down. The industry suffers from limited resources, while at the same time striving to accommodate growing community and regulatory expectations.

It was only back in March, in preparation for the current planning round, that the problem of aging infrastructure and meeting the requirements of Audit NZ were cited as amongst the top issues facing councils.

Audit NZ warned that "If a public organisation does not have a good understanding of its most important assets, particularly the condition of those assets, it risks making poor long-term decisions"

Currently most councils have had funding and programme constraints. Whilst operating within these constraints, it is imperative that programmes to understand the condition and performance of water assets are not seen as non-essential activities.

An important consideration therefore, is that all councils should obtain good reliable information on the condition and performance of their water assets. They can then understand what assets need renewal now and which can be renewed later when the fog has cleared with confidence. Without this understanding effective implementation plans and good decisions cannot be made..

Key points to consider:

- Optimised renewal plans may require less funding
- Accurate renewal forecasts can inform accurate depreciation profiles for rates calculations.
- Inspecting and assessing critical assets are important to avoid failure and associated financial and reputational cost
- An outcome of good practice is the confidence that the asset owner has in the knowledge of their assets' performance and therefore the work required to maintain or exceed that performance.

As the fog begins to clear, the window of opportunity to continue to gather information for inclusion in this year's planning round is rapidly closing.

What is clear, is that our industry still needs to do its day job and do it well !

At ProjectMax we understand the challenges for local government and this is why we have been working with Councils throughout the country for many years. We have guided councils to develop strategies, plans and programmes to provide confidence in the information they have gathered. They can then make informed decisions on creating, maintaining and renewing their water assets.

Broadening Our Offering

We are very pleased to announce that Ian Garside has joined ProjectMax as a partner. Ian's breadth of knowledge and experience helps broaden our service offering and has been working with most councils in various roles for many years. "We know that ultimately asset owners want well managed assets based on reliable information and robust plans" comments Ian. "In order to do that, they need to know how to obtain the good information that is needed and to develop clear strategies for creating and renewing assets. At ProjectMax we can help them with this".

Creating tranquillity for the America's Cup

Based on a paper by David Pattinson from the Wynyard Edge Alliance, which is made up of McConnell Dowell, Downer, Beca, Tonkin and Taylor, Auckland Council, and the MBIE.

Healthy Waters, Auckland Council's stormwater division, owns and maintains the Daldy Street Outfall, an asset used to discharge approximately one third of Auckland's CBD stormwater drainage into Wynyard Basin, which is also the new location for several of the 36th America's Cup (AC36) syndicate bases.

The existing outfall discharges directly into Wynyard Basin, at the junction of Wynyard Wharf and North Wharf, adjacent to the old SeaLink facility.

A condition of AC36 was that the basin required 'tranquillity' and the existing outfall compromised this. The outfall needed to be relocated and the decision was made to extend the pipeline along the full length of Brigham Street, discharging into Waitemata Harbour via a new outfall structure.

With construction of AC36's infrastructure already underway, in particular the new syndicate bases on Wynyard Point, it became apparent that relocation of the pipeline would need to be done concurrently with the AC36 work. As such, the Daldy Outfall extension was added to the scope of the AC36 project and contracted to Wynyard Edge Alliance (WEA).

The project involved a technically challenging ground stabilisation system and the installation of what is believed to be the largest diameter pipe ever laid in New Zealand. This was all within contaminated land, in tidal conditions, through the middle of construction of the syndicate bases, to an extremely tight timescale.

Innovation was key. The engineering and temporary works teams worked collaboratively with the construction team to develop, and ultimately produce, a highly technical solution that removed the need for anyone to enter the trench during pipeline installation. A safe, sustainable, robust, cost-effective solution was developed, priced and subsequently installed.

Wynyard Point: a peninsular on the north-west corner of Wynyard Quarter, Auckland.

The site

Wynyard Point is a peninsular on the north-west corner of Wynyard Quarter in Auckland's CBD. The area is bound by Brigham Street to the east and Hamer Street to the west and was reclaimed around 100 years ago from the Waitemata Harbour.

A basalt breakwater was constructed around its perimeter with a concrete seawall cast on top, then infilled with excavated arisings (from the early CBD development) and hydraulic fill/dredged arisings (from the sea).

Once capped off, the area was developed as an industrial site, with gas works, fuel storage tanks, etc, occupying the site. The ground has substantial quantities of hydrocarbons, fuel oils, asbestos, 'blue billy' (by-product from gas works), scrap steelwork and various other obstructions.

All of this classified the area as a contaminated zone, requiring air monitoring and the use of disposable overalls and gloves when any works were carried out.

The relocation design

The Daldy Street Outfall discharges into Wynyard Basin at the south-east corner of Wynyard Point and, amongst other things, the scope for the AC36 project required the need for tranquillity in Wynyard Basin and the possibility of turbulent stormwater overflows into the basin, from the outfall was undesirable.

The outfall had to be relocated, and following investigation of several possible locations, the northern tip of Wynyard Point was selected. This involved the extension of Daldy Street Outfall by some 510 metres along the entire length of Brigham Street. The new outfall would discharge directly into the Waitemata Harbour, maintaining tranquillity within Wynyard Basin.

Furthermore, with the obvious clash between works for Daldy Street and AC36's syndicate bases, the only viable solution was for WEA to execute the works as a variation to the AC36 contract, thus managing the interface with AC36 works.

The outline design was developed, target cost provided and ultimately agreed, and a variation issued for the additional works.

Site investigation

The first step of the design process was to initiate a detailed programme of geotechnical investigation. The focus of this was to determine the location and extent of the basalt breakwater along the eastern edge of Brigham Street; location and extent of an old haul road believed to be formed along the back of the basalt breakwater; physical properties of the backfill material used to construct Wynyard Point; contamination levels; information on water levels; integrity of the existing seawall; and anticipated construction loadings.

Information relating to utility services was also collected and this revealed a major issue with a fire-fighting water main. This would need to be diverted/relocated several times during the construction phase in order to maintain a fire-fighting provision for the Stolthaven tank farm and Wynyard Wharf, both adjacent to our work site.

Pipe design

Hydraulic analysis identified that a pipe diameter of at least 3000mm would be required for the project.

The existing pipeline in Daldy Street was 2700mm diameter with little or no fall due to the topography of the reclaimed land within which it was laid.

Furthermore, there existed very little driving head to flush the pipe, and with it being so close to the harbour, the pipe was subject to tidal flows.

The maximum diameter concrete pipe available in New Zealand was 3050mm (concrete) with an effective length of 2700mm; this would have complicated the connection detail and slowed down the laying process considerably. In addition, nearly 200 pipes would be required, significantly adding to the carbon footprint associated with manufacture and subsequent delivery into the CBD.

The final design landed on a 3000mm pipe for the upstream half of the extension and a 3500mm pipe for the downstream half.

With concrete not being a viable option, an HDPE solution was pursued. The main advantage of HDPE pipe is that it is made from an extruded rectangular section (wound onto a mandrel) with the rectangular section effectively producing a void within the pipe wall; this makes it extremely light, while remaining very strong.

Additionally, it is extremely flexible, with manhole sections, lateral connections and an expansion piece all capable of being factory produced. The pipe could be supplied in 15 metre lengths, which would greatly assist in the installation process, speed up production, and provide a better Health and Safety solution.

Following much discussion, an order was placed with Uponor, with fabrication to be done in its Thailand factory. After a 10-week fabrication programme, the pipes were transported to New Zealand by ship and delivery was made directly onto Wynyard Wharf, adjacent to Brigham Street. Two hundred truck journeys to Auckland's CBD had been avoided, providing a more desirable environmental solution.

A key feature of the pipeline design was the connection detail between adjacent pipes. A mechanical connection between pipes of this size was not possible, so a concrete cradle/saddle arrangement was designed with macalloy bars used to effectively clamp the sections together.

A strip of EVA compressible foam was detailed across the joint to maintain as good a seal as possible – this was not essential but seen as good practice.

Project stabilisation

Initial stages of design concentrated on the ground support required for the five metre deep excavation. With the basalt breakwater running along the eastern edge of the proposed trench, traditional double-row sheet piling was not an option. A second option of providing a single-row sheet pile (to the landward side) and then tying back proved unworkable as the strength of the reclaimed land would not support any type of tieback or anchor.

The preferred option soon became in-situ mass stabilisation, formed by mixing grout with the existing ground, effectively

forming a low strength 'concrete' mix. The idea was to stabilise the full 12-metre width of Brigham Street, then to dig through the treated ground to lay the pipe.

However, a trial of the method failed as the equipment was not powerful enough to penetrate some of the fill. The design had to be re-thought.

At this stage, we sought advice from an international ground-engineering expert who introduced the team to the 'Cutter Soil Mixing' (CSM) method.

This method uses a powerful drill-rig with cutter heads mounted onto a kelly bar that are driven into the ground. Grout is injected behind the cutter heads as they descend, mixing the grout with the in-situ ground, similar to the initial mass stabilisation method, just more powerful.

The treated panels produced are 2.4 metres long and one metre wide (plan area of cutter head) and can be installed as deep as the kelly bar.

This ground stabilisation methodology was adopted and developed. The completed design used four abutting rows of CSM panels running the entire length of Brigham Street.

The CSM block would support the ground to the west of the excavation during pipe excavation / install. Furthermore, the mixing of existing ground with grout reduced the volume of excavation, and consequently the volume of contaminated material to dispose off-site – a more sustainable solution.

Project structures

Having completed the design of the pipe and ground stabilisation for its installation, the structures team undertook the design of the outfall structure; upstream connection into existing pipe; and manholes/lateral connections.

The outfall structure was designed to blend in with the existing basalt breakwater at the northern end of Brigham Street.

Due to the tidal nature of the installation, in-situ concrete was not a viable option so precast units were developed as the preferred solution. The headwall was split into five segments, following the sloping face of the breakwater. However, the shape of each unit precluded transportation from the precast yard (due to size constraints) so each unit was constructed from a pair of precast wall units, connected together on site with an in-situ base unit.

The client expressed a desire to blend the headwall in with the existing breakwater. To satisfy this requirement, the concrete panels were coloured with an eight percent (by binder volume) black oxide additive, and the wall units given a profiled finish to replicate a rock pattern.

Following installation of the precast 'U' sections within the breakwater, an in-situ pour was designed to tie the units together, at the top, out of the tide.

The structure was completed with the introduction of a flap valve across the pipe outfall, designed to discourage kayakers/ adventurous children entering the pipe and reduce the risk of prevailing winds blowing unwanted gases back up the pipe.

North Wharf connection

The existing Daldy Street pipeline runs northwards along Daldy Street, terminating at a point where it meets the northern edge of North Wharf.

An overview of Wynard point and the route of the new pipe.

The wharf is a 100-year-old reinforced concrete structure constructed with columns, beams, cross bracing, and a 200mm thick deck slab on top.

When Wynyard Point was developed (infilled), the existing outlet had no point of discharge and the solution was to break a hole in the side of the pipe and divert the flow along a newly formed channel. This arrangement has been in place for many years.

Access to the existing outlet is possible, albeit difficult. A survey team was able to undertake a comprehensive laser survey of the existing pipe under the wharf at the intended point of connection. From this survey, a detailed model of a transition piece was made to connect into the existing pipe and move the new alignment away from other columns of the existing wharf structure.

Bend/manholes/lateral connections

Due to the existing layout, a 24-degree bend was detailed to replicate the kink in the existing road alignment in Brigham Street.

Access to the pipeline would be required for maintenance, periodic inspection and cleaning. There is access under the flap valve at the outfall and, in addition, two manholes were added – one adjacent to the bend and one at the mid-point of Brigham Street. No ladders were detailed to discourage unauthorised entry.

As the Daldy pipeline design developed, drainage works for the AC36 syndicate bases were completed, and lateral connections for these outlets were catered for in the Daldy design.

We therefore added a 24-degree bend, two manhole sections and all lateral connections to Uponor's HDPE pipeline order. These were all factory made, fitted and delivered with the main pipeline onto Wynyard Wharf.

Installation

Working alongside the design team, our engineering team devised and developed the temporary works schemes required for the installation of the permanent works.

Collectively, the permanent and temporary works teams produced a robust, innovative, engineered solution for installation.

The key feature of the pipeline installation was that worker

The ground was littered with redundant pipes, scrap steel, chains, an old ship's boiler and propeller.

entry into the trench was precluded, due primarily to safety concerns regarding the depth and tidal conditions. All pipe installations were carried out from existing ground level, thus protecting the workforce – a critical feature of the design.

The CSM installation works were sub-contracted to Wagstaff Piling from Brisbane. The contractor mobilised equipment from Australia and set up its plant on site central to the new pipeline.

Following the extensive ground investigation work, it was clear there would be many obstructions in the ground that could hamper progress.

With this in mind, WEA set up an attendant team to initially dig a guide trench for each panel and then clear any obstructions if encountered. This proved to be very beneficial as the ground was littered with redundant pipes, scrap steel, chains, an old ship's boiler and propeller.

The phasing of the work had to dovetail in with progress on the AC36 syndicate bases and infill bridges. By careful planning and integration with the other teams, we were able to maintain progress on site without delay to any party.

Five months after commencing work, and 959 CSM panels and 13,000 cubic metres of treated ground later, the CSM works were successfully completed.

In order to monitor the behaviour of the CSM panels during excavation for the pipeline, inclinometers were installed at regular intervals along the length of the pipeline. There were concerns relating to a horizontal displacement

of the panels during excavation that could lead to a vertical deformation behind the panels; this could subsequently lead to differential settlement of Stolthaven's fuel tanks in the northern section of Brigham Street.

These concerns never eventuated and the CSM walls behaved well, with horizontal displacements typically less than 10mm.

Site excavation

With ground stabilisation in place well ahead, excavation for the pipeline could begin. A 47-tonne excavator was selected for the five metre deep excavation. This was a compromise between digging power, reach, swing radius, and ground bearing pressure on the existing road/seawall.

The tidal range of the adjacent harbour runs between pipe invert and pipe crown; with the porous breakwater alongside, it was thought that water would always be present within the excavated trench, typically following the tide. This proved to be the case.

Excavation of the trench would follow the vertical face of the installed CSM panels (row 1) to the west and the seawall/basalt breakwater to the east. Control therefore centred around the depth of excavation, which would always be underwater.

To assist with this 'blind' dig, a GPS sensor was fitted to the excavator and formation of the trench bottom was controlled electronically. At each cradle position, a slight over-dig was required to allow for the thicker cradle; the GPS catered for this. Excavation was carried out to 100mm below the underside of the concrete cradles (used to support the pipe).

The excavated ground was extremely variable, with reinforced concrete sections (thought to be an old damaged wharf structure), steel pipes, steel rope, 'blue billy', pockets of hydrocarbons, basalt boulders and weak soils – all encountered on a regular basis.

At times, the water within the trench became very dirty/oily, and environmental measures such as plugging holes in the seawall, adding oil booms/silt-socks within the harbour, pumping / sucking out to the treatment plant were instigated. Although minor leakages occurred, there were no pollution incidents, which was considered a major risk during the design phase.

All excavated material was transported to a spoil handling area, where it was sorted and either disposed of off-site or mixed with cement to form mudcrete that would later be used as backfill for the pipeline. Due to the contaminants found in Brigham Street, the site was deemed a contaminated zone, hence the need for disposable paper overalls and gloves.

Pipe installation

After sufficient excavation had been completed, the first concrete cradle could be installed. With a minimum of one metre depth of water always present in the trench, inspection of the formation and setting levels from within was not possible.

To overcome this, a steel gantry was utilised, spanning between the existing seawall and the CSM wall, to suspend and position each cradle.

Concrete cradle for pipe support being lowered into place.

The precast concrete cradles were prepared for installation; macalloy bars screwed into the top were used to suspend the cradle from a spreader beam above and a grout bag strapped underneath.

The spreader beam with cradle were positioned above the steel gantry and lowered down through a central opening. Lowering continued through the opening until the spreader beam sat on the cross beams of the steel gantry.

By careful surveying, the cradle was positioned and suspended off the steel gantry at the correct chainage, offset and reduced level.

After a final survey check, a grout pump was connected to a hose on the grout bag and approximately two cubic metres of grout pumped into the bag, filling the void between the underside of the cradle and the formation below. Following an overnight initial setting period, the spreader beam and gantry were removed, leaving the cradle in its final correct position.

With water levels typically higher than the top of the installed cradle making it invisible, a survey frame was temporarily placed on top of the cradle to assist with surveying. Once set in place, the frame was removed.

Prior to installation, each pipe was positioned on a preparation frame. Preparation included the removal of temporary 'spiders' welded across the open ends to maintain the pipe shape during transportation and adding water and air vents to the top of the pipe. By rotating the pipe on the frame, the need for 'working at height' was eliminated.

Following preparation of the pipe, two lifting straps were wrapped around the pipe and connected to a bespoke spreader beam. The pipe was lifted from the preparation frame and lowered into the excavation between the next pair of cradles. However, as the pipe was lowered into the water, the buoyancy of the pipe would force the pipe to float.

To overcome this, water was added through a central port on the crown of the pipe that filled the helical annulus, venting at either end. This operation effectively tripled the weight of the pipe and allowed it to settle into the cradles below.

With the pipe sunk into position, saddles were added to the pipe ends and bolted down to the cradles below. Two additional saddles were also landed onto the pipe (at third points), which would prevent uplift during the next operation.

During the design phase, it was identified that laying pipe bedding under such a large diameter pipe, and underwater, would be extremely difficult. To this end, a flowable fill was specified, which would be trammied in underwater.

The additional temporary saddles would prevent uplift of the pipe. A wooden staff with a laser target attached to the top was used to check the height of the flowable fill poured – the finished surface being approximately one metre above pipe invert and always below tide level.

The final stage of pipe laying was backfilling the remaining pipeline with the mudcrete produced in the spoil handling area (by mixing selected excavated arisings with cement). The target strength of mudcrete was 1 MPa, which was regularly exceeded. The mudcrete was returned to the pipeline area and deposited by excavator in layers.

The process of excavation, cradle install, pipe laying, flowable fill and mudcrete backfill continued on a cyclic basis along the entire length of the pipeline.

An additional feature of the temporary works design was purpose built 'pigs' that were installed in the first full pipe laid (of each diameter) and pulled through the sections of completed pipe. This had the effect of cleaning any silt and debris from the pipeline as installation progressed, negating the need for a final clean out upon completion.

Project sequencing

Against common practice, Phase 1 of the pipeline installation commenced at the central point of the 510 metre extension and headed in a southerly direction, thus clearing syndicate bases C, D and E in a timely fashion.

The non-mechanical connection, symmetrical pipes, and a flat invert facilitated this, enabling the AC36 finishing works to be completed and milestones associated with the project met. Installation continued as far as North Wharf, stopping two pipes short of the connection point, which would be re-visited once the outlet was formed.

At this stage, pipe laying returned to the starting point and Phase 2 headed in a northerly direction towards the outfall structure. Having made the final connection into the completed headwall, the operation returned to the southern end to make the final connection into the existing point of outfall.

As mentioned earlier, the shape and size of the outfall units precluded precasting in one unit. Because of this, the (patterned, blackened) wall sections were precast in Busck's yard in Whangerei and transported down to site. Once on site, each pair of walls was set upon a casting bed situated on Wynyard Wharf, alongside the new outfall position. An in-situ base slab was cast between the walls to tie them together and form a 'U' shape section.

Prior to the pipeline installation reaching the northern end of Brigham Street, excavation commenced for the new outfall structure. Additional CSM panels had been installed to the rear of the outfall to allow a steepened back wall of excavation and to provide a stabilised area for the crane to sit on while lifting in the 'U' sections.

Again, excavation utilised GPS to allow the correct formation level to be achieved one metre below lowest tide.

Left: Precast outfall wall panel. Above: Pipe installation underway.

Excavation commenced with the excavator but was completed by a barge mounted excavator due to access difficulties.

Upon completion of excavation, a prefabricated steel frame was lowered into the excavation with diver assistance. The frame was fabricated with four adjustable legs (to set to the required level), scaffold poles with survey targets added (to assist positioning below water), and angled guides to assist landing the precast sections.

Once positioned correctly, concrete was poured within the frame to within 50mm of the top flange. A grout curtain was installed around the perimeter of the frame to contain the concrete, and a sliding screed rail was added to the frame to assist in screeding the concrete to the required level – a difficult operation for divers underwater.

With the seating frame set and precast units completed, a 400-tonne mobile crane was set up above the outfall structure, which lifted each of the five 'U' sections into the water and onto the seating frame. The first (downstream) unit was set against a steel angle section to locate the downstream toe, and subsequent units lowered in and placed against the previous unit.

With the five 'U' shaped units installed, the backwall sections were lifted in and bolted to the upstream unit, and the final cradle lifted in and bolted to the backwall, ready to receive the last pipe.

The final stages of the headwall construction were to concrete around the outside of the seating frame to lock it in place, construct an in-situ tie beam to connect the tops of the wall panels together, and grout the void between the 'bedding' concrete and the underside of the units.

This final operation was undertaken with divers using an intricate system of grout tubes and bleed valves to ensure the seawater below the units was fully displaced during the grouting operation.

Upon completion of the headwall, the working space created during initial excavation was backfilled with basalt boulders, blending the new headwall into the existing breakwater. Completion of the headwall allowed for excavation and laying of the last two pipes into the back of the completed structure.

The North Wharf

To complete the Daldy Street Outfall extension, it was necessary to tie the newly laid pipeline into the existing pipe under North Wharf. This followed completion of the pipeline downstream in order to provide an outlet.

With ground stabilisation provided by the previously installed CSM panels, excavation commenced between North Wharf and the previously laid pipe – a distance of approximately 10 metres in length. Excavation continued under North Wharf (under tidal conditions), including breaking through the existing retaining wall.

As excavation progressed, blinding concrete was laid on the formation as the flow of Daldy would soon pass over this area – environmental protection was thus afforded.

The stainless steel transition piece was connected to the first HDPE pipe section, and the whole unit lowered over the edge of North Wharf, at low tide, into a rope sling hung off the side of the wharf.

With the weight of this combination pipe taken by the main hook on the crane, an auxiliary line was threaded through a hole in the wharf, directly above the connection point and onto the end of the transition piece. On the incoming tide, the weight was taken off the crane as the pipe began to float. At this point, the auxiliary line was hoisted and the pipe section pulled into place under the wharf and into position – the stainless steel transition piece fitting into the old outlet. The annulus of the pipe was then flooded, sinking the pipe into position.

The flow of Daldy pipeline immediately started to run through the new pipe, through a short 10m section of excavation, then through the remaining pipeline previously installed.

At this stage, all that remained was to measure and cut the final pipe, place it in the remaining gap and add the final pair of saddles to clamp it in place.

The final diversion of Daldy Street Outfall had been successfully completed.

Street reinstatement

Following completion of the diversion, reinstatement of Brigham Street North is required, which includes a single carriageway road, swales to receive surface run-off (connected into the Daldy pipeline), a footpath, and miscellaneous lighting, signage and road marking.

The final touch will be to replace the five Pohutukawa trees removed to facilitate the works, with nine new trees planted. Completion is due August 2020.

Project wrap up

Integration of designers, temporary works teams and construction staff, from an early stage, enabled an innovative, effective, technically sound, and safe system of design and installation to be developed.

As each design package was issued, a full understanding of design requirement and proposed installation method had been gained.

Construction Execution Procedures were developed alongside the design, with input not only from construction and design team members, but also representatives from the health, safety, environment and quality (HSEQ), contamination, stakeholder, owners, and consenting teams. This team effort was extremely valuable.

Crucially, the design and installation method developed included a number of innovative solutions. These were: CSM ground stabilisation; GPS controlled excavations; preclusion of worker entry into the pipe excavation; steel gantry to support pipe cradles; use of steel survey frame; grout bags to set cradles; a highly flexible pipe material – HDPE; possibly the largest pipe ever laid in this country; pipe laying through tidal conditions; flooding of pipe annulus to allow sinking of pipes; flowable fill placement underwater; use of mudcrete to reduce disposal; precast elements to headwall; use of headwall seating frame underwater; grouting of precast units underwater; and installation of transition piece under North Wharf.

Furthermore, coordination between the Daldy installation team with other AC36 construction teams (syndicate bases, infill bridges, etc), played a huge part in the successful execution of the project and allowed all project milestones to be met.

The flow of the Daldy Street Outfall has been successfully diverted, providing improved water quality for Healthy Waters and allowing full tranquillity of Wynyard Basin to be achieved in time for the 36th America's Cup event.

Carbon baseline and your carbon footprint


Like many New Zealand organisations, councils and water utilities are at the start of their journey to plan and budget for reducing their carbon footprint to meet the Zero Carbon Act target of net-zero greenhouse gas emissions by 2050. By Caroline Hope (left), Process Engineer and Emily Sopers, Environmental Engineer, Beca.

A carbon footprint is the greenhouse gas (GHG) emissions footprint expressed as carbon dioxide equivalent (tCO_2-e).

In order to begin this journey, it is important to confidently understand the extent of these emissions by developing a carbon baseline that is used as the foundation for a carbon roadmap which can show what pathways are available to practically meet the target.

Various international studies show direct (Scope 1) emissions – those emitted from owned or controlled assets – are released from various points of a wastewater treatment plant (WWTP). The Intergovernmental Panel on Climate Change (IPCC) has synthesised these studies to develop a guideline for quantifying emissions from different types of WWTPs[1].

These direct emissions include two potent greenhouse gases: methane (CH_4) and nitrous oxide (N_2O) which are often released at very low concentrations. Over 100 years their respective global warming potential (the amount of warming per unit of emission) compared to carbon dioxide for CH_4 and N_2O is 25 times and 298 times respectively.

As a result, even if small amounts of these gases are emitted from a WWTP, they can contribute significantly to a plant's operational carbon footprint. To date, these direct CH_4 and N_2O emissions have been overlooked in carbon footprint assessments – it is time to draw back the curtains.

We choose to adopt the IPCC guideline to initially estimate direct emissions released from WWTPs. The guideline is an internationally verified methodology containing default emissions factors based on international studies where onsite testing of emissions factors is carried out.

As onsite testing is yet to be conducted at any NZ WWTP, we are forging new ground when it comes to applying the IPCC guidelines to the NZ context.

What's contributing to the carbon footprint of your WWTP?

Beca has been working with WWTP owners around the country to baseline two emissions types:

- Operational carbon, which are emissions associated with the operations categorised into Scope one (direct CH_4 and N_2O, on-site energy use); Scope two (electricity); and Scope three emissions (e.g. biosolids management, chemical consumption).
- Capital carbon – emissions associated with the creation of assets projects, those embodied in materials and used in construction processes (tCO_2-e).

These baselines can be used as the foundation for a carbon roadmap, where the carbon and cost impact of the different options can be realised to help prioritise projects, programmes and make informed decisions, in pursuit of net-zero carbon by 2050.

Scope one Emissions

Operational carbon baseline assessments with Hamilton City Council (Pukete WWTP) and Queenstown Lakes District Council (Project Shotover WWTP) showed that the direct, CH_4 and N_2O emissions make up over 80 percent of each plant's Scope one operational emissions. The remainder of Scope one emissions are typically associated with onsite energy use.

For both Pukete and Project Shotover, dissolved CH_4 is likely generated in the sewer network and released at turbulent points in the plant and the nitrogen removing reactors are a source of N_2O emissions. The residual carbon and nitrogen in the effluent are likely to generate CH_4 and N_2O emissions respectively, in their discharge environments[2].

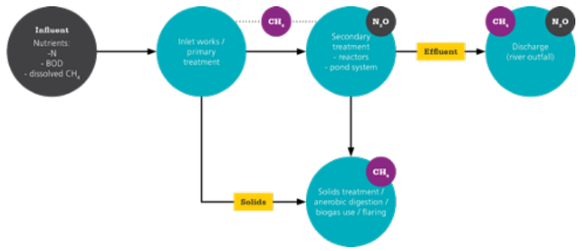
Pukete's solids stream process units, the largest contributor to direct emissions, are also the greatest opportunity for reduction. The council plans to improve the anaerobic digestion and biogas system to reduce their operational carbon footprint. The baselining process emphasised that this investment will be impactful for their journey to net zero carbon.

Project Shotover's greatest opportunity for emission abatement sits with the facultative pond system, a key source of CH_4 emissions. It is soon to be decommissioned as part of the Project Shotover WWTP Upgrade Stage 3, which would enable the WWTP to meet the 2030 Zero Carbon Bill target of 10 percent reduction in biogenic CH_4 emissions.

These are just two of the WWTPs we have been working with from around New Zealand. The results so far show us that, even when accounting for uncertainty, direct CH_4 and N_2O are significant to a plant's carbon footprint and cannot be overlooked.

1. IPCC. (2019). Wastewater Treatment and Discharge, Chapter 6, Volume 5, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. USA: Intergovernmental Panel on Climate Change.

2. IPCC. (2019). Wastewater Treatment and Discharge, Chapter 6, Volume 5, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. USA: Intergovernmental Panel on Climate Change.



Direct Sources of Methane and Nitrous Oxide Emissions from a Wastewater Treatment Plant.

Scope three Emissions

Carbon baseline assessments typically included Scope three emissions to help WWTP owners understand the upstream and downstream emissions associated with their plants.

Biosolids management emissions are a carbon hotspot if the biosolids of the WWTP are trucked and disposed of in landfill. Around 90 percent of the biosolids in New Zealand are sent to landfill and this carries a significant carbon impact for the industry, but is likely to be the greatest reduction opportunity. Biosolids management strategies, such as beneficial re-use for landscaping, could be an opportunity to offset a WWTP's carbon emissions.

Where does the Water Industry go next?

Case studies around the world present reduction opportunities, but without an accurate carbon baseline it is difficult for a WWTP to understand where the hotspots are and what capital investment to prioritise.

There is uncertainty with using default activity data and emissions factors in the IPCC guidelines.

Although all options can establish a strong starting point for emissions estimation, the last option will give a WWTP owner the most confidence in their baseline emissions.

Due to the low concentration levels of emissions, particularly for N_2O, appropriate onsite testing equipment and associated logistics are difficult and expensive in New Zealand. Investment in the equipment at an industry level, could alleviate the cost constraints that each WWTP owner would otherwise incur.

If such investment was made, New Zealand specific benchmarks could be developed for WWTPs to measure their progress against.

How to find out more information?

At the New Zealand Water Conference in September, Caroline Hope and Emily Sopers from Beca, and Evan Vaughters and David Hight from Hamilton City Council will present on the options for estimating emissions and on-site emissions testing. With a bit of luck, in this post-pandemic period they will implement the testing before the conference and present results.

The Water New Zealand Climate Change Special Interest Group will be working hard in the short term to support WWTP owners with information and resources to better understand their emissions.

case study

Maori land wastewater project

Kristina Hermens, a Beca secondment to the Tauranga City Council, and David Lenton from the Tauranga City Council discuss the application of community cultural values at the Matapihi Wastewater scheme.

Matapihi is a mainly Maori rural community located within urban Tauranga. The community has faced the pressures of surrounding urban development for a number of years and has a strong drive to maintain its rural and cultural character.

Recently, the Matapihi community was connected to the Tauranga City Council wastewater network in a manner that accommodates its cultural values and supports aspirations to improve public health and the local environment, while supporting the community to live on its traditional land for now and the future.

Matapihi Landuse Plan

Matapihi is unusual as it is a rural community (where approximately 700 people live on mainly traditional land of Ngati Tapu and Ngai Tukairangi, centred around two marae) within an urban city of approximately 140,000 people.

In 2006, Tauranga City Council applied for resource consents to construct a wastewater interceptor through the middle of the Matapihi peninsula (to convey wastewater from the city's southern growth areas to its Te Maunga wastewater treatment plant).

During consultation, while fundamentally opposed to the scheme, as a mitigation the community expressed a desire to connect to the city's wastewater system and it was agreed that this would be considered during the development of a landuse plan. In 2007, Council engaged with the community to prepare a landuse plan underpinned by two key messages: housing development rules were too constraining and that Matapihi should retain its rural character.

The first key message refers to the community's desire to develop papakainga housing (housing developments on traditional land), particularly around the two marae.

The outcomes from the Matapihi Landuse Plan were implemented in the next Tauranga City Plan, which provided guidelines for papakainga developments in Matapihi. As the underlying zone would remain rural, it was agreed that wastewater would continue to be managed via on-site effluent treatment systems.

Connection to the wastewater network

In 2015, during construction of the wastewater interceptor, the topic of connecting the community to the public wastewater network arose again.

The construction of the interceptor presented the community with an opportunity to connect to the network that facilitates further development of their papakainga housing while at the same time improving public health and protecting the environment from the effects of the septic tank systems.

Council and community leaders later met and agreed to connect properties within the marae community zones to the public wastewater network. The zones contain up to 100 houses, two marae, a primary school (kura), an early learning centre (kohanga reo) and a medical centre (hauora). The main drivers were protection of public health and the environment.

A low-pressure sewer system was selected due to the flat grade of the land and low population density across the community. A pressure sewer collects wastewater into a chamber located on private property which is then pumped into the network.

Public works on Maori land

The majority of dwellings in Matapihi are owned by occupiers who lease sections on multiple-owned Maori land. Typically, occupiers own their house and pay council rates for their section. However, land property rights remain with the landowners.

As a low-pressure sewer scheme requires the installation of council owned pump chambers and pipelines on private property and connection was optional, council needed to gauge interest from occupiers and then obtain permission from landowners before designing the works.

This took additional time as residents needed to decide if this option suited them and whether they wished to pay the subsidised connection cost and ongoing rates. The council also needed to identify who to obtain the correct permissions from, especially where pipelines traversed multiple properties. Written agreements were required from both landowners and occupiers before on site surveys and designs could commence.

The support of community leaders was instrumental in communicating the public health and environmental benefits of a reticulated wastewater network to the wider community. Approximately 85 percent of eligible properties accepted the offer of connecting to the public wastewater network. Note that properties located within the eligible zone may connect to wastewater network at any time within the future subject to capacity and development costs.

Community engagement

This project provided Tauranga City Council with a valuable opportunity to build trust and improve its relationship with the Matapihi community.

An important factor in selecting the physical works contractor was their ability to work collaboratively and safely within a community with differing opinions on the wastewater scheme.

Before starting work, the council held 'Meet the Contractor' evenings that focused on methodology and programme, including how residents may be affected during construction. It was important to forewarn the community about the scale of construction machinery (particularly for the larger tanks installed at community facilities) and how long the contractor would be working on properties.

Construction workers were 'blessed' and undertook cultural inductions prior to starting work on each marae. Cultural earthworks monitors from the community became part of the construction team and assisted with Maori protocols (tikanga) and liaising with residents.

Specific protocols were also agreed between the community facilities' representatives and the contractor. Works at the school and early childhood centre were timed during the school holidays.

Works at the marae were carried out around planned events and processes were agreed for unplanned events, such as funerals (tangihanga). There were a few tangihanga at each marae during construction and during these events, the contractor made the site safe and removed machinery and workers for the duration of the funeral rites.

Council also engaged a local community member to liaise and be on-site for personalised one-on-one community attention. This proved successful as most residents used this channel to address issues and ask questions.

The community liaison worked closely with the contractor and residents to negotiate the location and timing of drainage works and also address any issues during construction and early operation of the system.

Particular care was also taken to determine the most effective form of communication, such as: face-to-face meetings, letter drops, emails, regular newsletters, one-off flyers, notices on the project website and community social media groups.

This included brochures on the operation of the wastewater system, preventing blockages (e.g. flushing wipes) and who to contact if servicing is required.

Lessons learned during construction

Construction of the wastewater scheme was carried out from October 2018 to August 2019. The installation of the low-pressure sewer scheme required several visits to each property to survey the land, survey the electrical switchboard and then

different construction crews to complete the works. Over Winter, construction was also delayed due to wet weather.

The collaborative and respectful attitude of the contractor's staff minimised complaints during construction. Most residents were tolerant of the disruptions caused during construction but future contracts could benefit from streamlining the construction methodology to minimise the time spent on each property.

The large tanks installed on the two marae were designed to accommodate standard traffic loads and were to be protected from heavy traffic loads by bollards. During consultation with marae representatives, there were concerns about the visual effects of bollards.

This offered an opportunity to improve the visual and recreational amenity of each marae while protecting the tanks from potential traffic damage. Council worked with marae representatives to plan garden beds and seating areas over the tanks. Low maintenance ornamental native plants were selected as edible or medicinal plants would be culturally incompatible with a wastewater system.

Aerial photo showing Matapihi peninsula.

In subsequent projects, the council has used tanks designed to withstand heavy traffic loads, removing the need for bollards or landscape features.

Critical success factors

Some of the important lessons learnt and critical factors for success in this project were:

- The importance of understanding the history and how a community feels about an infrastructure project, and tailoring actions to consider community values and to minimise offence or disruption.
- Support from community leaders is critical to communicate the benefits of an infrastructure project and to obtain insight into community concerns and issues.
- Establishing an engagement process that matches community values, key aspects were to engage early, to engage face to face and to ensure all information was complete and accurate.
- Allow for additional time to engage with landowners and occupiers to obtain land permissions and keep communication channels open.
- Involve the right people during construction – select qualified contractors who value customer service and who can work respectfully on private property. Engage earthworks cultural monitors and dedicated liaison staff who know the community.
- Engage dedicated on-site community liaison – engaging a member of the community to work with the contractor and residents can improve communication and resolve issues promptly as they arise
- Regular communication with the community on their preferred platforms – understanding the level of information required for each stakeholder (e.g. absentee landowner versus occupier) and where they receive information is important to keep the community informed.
- Understand the ongoing effects of infrastructure and develop mitigation solutions with the community – look for opportunities to incorporate improved visual and recreational amenity into an infrastructural solution. Provide educational information on the operation and maintenance of the wastewater system so that residents can prevent wastewater blockages and know who to contact for service.

An improved and sustainable future

Existing residents within the Matapihi marae community zones have benefited from connection to the public wastewater network and decommissioning of their septic tanks, as there is less environmental impact and more usable space on their properties.

As more homes are built on family (whanau) land within the eligible zone in the future, they will also be able to connect to the public wastewater network. This supports the community's aspirations to improve public health and the environment, while allowing them to live on their traditional land for now and the future.

Walking to make a difference

Article supplied by Oxfam.

Oxfam Trailwalker, New Zealand's largest team endurance event, raises funds to support efforts to eliminate poverty and injustice, including delivering clean drinking water to families in Papua New Guinea.

In a pandemic world, access to clean water is needed now more than ever before. Installing freshwater taps prevents disease and dangerous treks to water holes for the world's most vulnerable. The concept for Trailwalker participants is simple – you walk so they don't have to.

In a world plagued by disease, vulnerable communities fear the worst. Every day, people in Papua New Guinea face life-threatening risks due to the long-term lack of access to sanitation and safe water.

For women like Javoto, the need for clean water is a battle fought every day. Javoto leaves her home at six o'clock in the morning each day to fetch water. Once she arrives at the waterhole, she must wait for several hours until those who arrived before her collect their water. When she finally fills her containers, Javoto makes the gruelling trip back with full jugs on her head and back.

"Sometimes I fall on the stones and hurt myself on my arms and legs. But I get up again and carry the containers even though I am in pain, because who else will carry the containers?

"I have headaches carrying the heavy load of water containers on my head. I have backaches along the way so I rest in between carrying the containers up the mountain to the house."

The journey is even more exhausting and dangerous for pregnant women and new mothers who must carry their new-borns while fetching water. As a mother herself, Javoto worries about providing clean water for her family as there is no guarantee it will be safe.

The river where Javoto fetches her daily water from also serves as a dumping ground for rubbish and human waste. Water and sanitation related deaths account for nine percent of total deaths in Papua New Guinea, making it one of the country's biggest preventable killers.

"Many people have died from typhoid from the water. My children have also been sick. We went to the hospital and they were diagnosed with typhoid from the water."

There is an urgent need for access to a local and safe water source to keep people like Javoto and her children safe from deadly diseases.

Oxfam Trailwalker is an opportunity for people and their workplaces to challenge themselves and challenge poverty. By participating in Oxfam Trailwalker, funds that are raised support people and communities like Javoto.

Oxfam Trailwalker typically raises almost a million dollars each year to support clean water and sanitation initiatives. Teams of four start and finish together and tackle either 100 kilometres in 36 hours or 50 kilometres in 18 hours to raise vital funds. This includes providing life-saving support to people like Javoto.

Oxfam New Zealand urges corporates and businesses to get behind the cause and encourage their employees to challenge themselves while raising funds for life-saving work.

Charlene Fitisemanu, Oxfam New Zealand's corporate relations executive, says; "Oxfam Trailwalker is a life-changing, team-building, friendship-forming experience.

"Taking part as a company in Oxfam Trailwalker is guaranteed to make a massive difference on communities impacted by the threats of climate change and inequality.

"It's one of New Zealand's best team endurance challenges – sign up a team and get the whole company behind this amazing cause and experience of a lifetime."

Left: Up in the Eastern Highlands of Papua New Guinea Javoto Heti stands outside her home with the tank of water she has collected from the local waterhole near her village. (Photo: Patrick Moran/Oxfam) Right: A corporate team on their Oxfam Trailwalker journey. (Photo: Photos4Sale/Oxfam)

Endurance activities like Oxfam Trailwalker also promote employee well-being, increase team-building capacity and boost overall productivity.

Registrations are now open for Oxfam Trailwalker 2021, which is due to be held during March 20-21, 2021 – for the very first time in the award-winning Taranaki region.

Step up to this incredible team challenge and take advantage of the early-bird price until 31 August by registering at www.oxfamtrailwalker.org.nz.

For more information on how your organisation can get involved with Oxfam Trailwalker, visit the website or call on 0800 600 700.

Pandemic recovery
a legal perspective

In this article we review the Covid-19 Recovery (Fast-Track Consenting) Bill, and provide an update on the various policy and legislative programmes our Government has underway, plus we look at a relevant case from the courts.

By **Helen Atkins,** Director and
Tom Gray, Solicitor, Atkins Holm Majurey.

Covid-19 Recovery (Fast-Track Consenting) Bill

This Bill has returned from the Select Committee, which recommended it be passed with amendments.

The Bill is intended to urgently promote employment growth to support our recovery from the economic and social effects of Covid-19. It also aims to support the certainty of ongoing investment across the country while continuing to promote the sustainable management of natural and physical resources.

This purpose of the Bill is sought to be achieved by establishing fast-track consenting and designation processes for infrastructure and development projects and enabling specific work on existing infrastructure to occur without the need for resource consent.

The Bill will establish expert consenting panels to determine applications for resource consents and notices of requirement for designations, and to issue certificates of compliance. This would replace the role of local authorities as consenting authorities under the Resource Management Act 1991 (the RMA).

The fast-track consenting process would be available for listed projects in the Bill and for referred projects (which go through a Ministerial assessment process).

The 11 listed Government-led infrastructure projects in the Bill have been assessed as suitable to be fast-tracked. Consent applications or Notices of Requirement for these will be automatically referred to one of the panels to consider and determine.

Private projects and non-listed Government projects can also apply to the Minister for the Environment to have their project fast-tracked where, if successful, the Minister would recommend making an Order in Council, which would refer the project to a panel to consider and determine.

These decisions would be made jointly with the Minister of Conservation if any part of a project is in the coastal marine area.

The Select Committee suggested various amendments to the Bill, including replicating 'Treaty of Waitangi' responsibilities from section eight of the RMA. This requires everyone exercising functions and powers under the Act to take into account the 'principles' of the Treaty of Waitangi.

The 11 Government-led projects include roads, cycleways, rail upgrades, water storage, and housing developments.

Applications for other public and private projects must provide information to the Minister on how the project meets the criteria specified in the Bill.

There is also an ability for the NZ Transport Agency and KiwiRail Holdings to undertake repair, maintenance and minor upgrade works on existing infrastructure in the road and rail corridor as a permitted activity, which means it would not require a resource consent. This process is subject to certain standards.

The fast track law is a short-term intervention that will self-repeal in two years.

Two-stage resource management reform

The Resource Management Amendment Act 2020 received royal ascent on 30 June, 2020. The Act makes critical changes to the Resource Management Act 1990 (RMA), particularly regarding freshwater, and aims to reduce complexity, increase certainty, and improve processes.

The Amendment backs up the Government's Essential Freshwater programme, allowing a faster process for regional freshwater plan changes to implement the new National Policy Statement for Freshwater Management 2020.

The Amendment also brings requirements for RMA decision-makers to consider the emissions reduction plans and national adaptation plans that must be published under the Zero Carbon Act for plan changes and consenting. Mandatory farm environment plans and requirements on reporting of fertiliser sales are also introduced.

Prosecution and enforcement powers have also been increased with higher infringement fees and longer timeframes for councils to file prosecution charges.

This is the first stage in the Resource Management reform, with a report from the RMA Review panel on a more comprehensive review due at the end of this month (July 2020).

Freshwater reform

The Ministers for the Environment and Agriculture have released the *Action for Healthy Waterways* package.

Importantly, this introduces new rules and regulations to stop further degradation of our freshwater resources and improve water quality within five years, and reverse past damage and bring freshwater resources, waterways, and ecosystems to a healthy state within a generation.

The package, originally released for consultation in late 2019, makes a number of significant changes after consideration of over 17,500 public submissions and the recommendations from an independent advisory panel. Various amendments have also been made in response to the pandemic.

The package will include a new and much awaited National Policy Statement for Freshwater Management 2020 (NPS-FM). This will provide local authorities with updated direction on how they should manage freshwater under the RMA, and comes into force later this year.

The NPS-FM includes requirements to give effect to Te Mana o te Wai; maintain or improve all water bodies using defined baselines; and expand the national objectives framework, including setting tougher bottom lines for the attribute Nitrate Toxicity.

The NPS-FM also sets out how it will avoid further loss or degradation of wetlands, target outcomes for fish abundance and diversity, and a requirement to monitor and report on freshwater, culminating in a synthesised report to be published every five years.

The package is the one of several upcoming pieces of national direction for freshwater management. National Environmental Standards for Freshwater and RMA Section 360 regulations for stock exclusion are also being introduced.

Guidance on these new rules and regulations will be released as they come into force.

The NPS-FM and other related documents are likely to be in the public arena in late July.

Case law update

Northlake Investments Ltd v Otago Regional Council [2020] NZHC 1144

This High Court case involves an appeal against the conviction and sentence[1] on a charge relating to a discharge of contaminants (silts and sediment) onto land that could have resulted in those contaminants entering the Clutha River.

The discharge occurred during earthworks for a residential development near Wanaka, resulting in the developer, Northlake Investments, being convicted and fined $42,500.

Northlake appealed the conviction, stating that the Judge had erred in the formulation of the charge and in finding that Northlake had failed to take necessary and reasonable precautions to prevent the discharge. The sentence was also appealed due to the disparity of the lesser fine imposed on Northlake's contractor, Civil Construction , which plead guilty to the same offence.

The Court noted that the appeal turned on the Judge's evaluation of the evidence of the steps Northlake took to prevent a discharge and the sufficiency of those steps.

The Court noted that Northlake had previously been put on notice for the inadequacy of its Sediment Management Plan which led to the Judge concluding that Northlake did not take the reasonable precautions of a prudent developer.

The Court held it was the failure of Northlake to insist on a stronger sediment control system that prevented Northlake from demonstrating that a miscarriage of justice had occurred.

Regarding the sentence appeal, Northlake objected to the starting point adopted by the Judge of $50,000 when $40,000 was adopted for Civil Construction. The Court found that Northlake had a greater level of culpability because it was the developer and ultimately the one responsible for environmental protection.

Despite Northlake's assertion that the two parties should have the same starting point due to contractual obligations, the Court found it was appropriate for the Judge to proceed on the basis that Northlake was responsible as a primary offender with ultimate responsibility.

Both the appeal against the conviction and the sentence were dismissed.

1. In decisions [2019] NZDC 11710 and [2019] NZDC 17582

Walkerton *E. coli* outbreak
20 years later

First published May 2020 in the American Water Works Association (AWWA) magazine 'Opflow' and republished with permission.

The systemic failures that led to the Havelock North water contamination crisis had striking parallels to an earlier event in Canada. Twenty years on from the Walkerton contamination crisis, Tom Clark, a former engineer with Monroe County Water Authority in Rochester, NY, and currently a trainer with the AWWA New York branch looks at how the outbreak, in May 2000, could have been minimised by common water treatment practices, including the use of chlorine residual and turbidity monitors.

It has been two decades since an *E. coli* outbreak contaminated water in Walkerton, Canada, but many people are still living with its after-math. The event's long-term impact includes elevated levels of kidney problems, irritable bowel syndrome, and arthritis as well as an overall lack of trust in the community's water supply system. The episode illustrates how the water treatment community is on the front line of public health.

Walkerton is a small community located northwest of Toronto. In May 2000, Walkerton's drinking water system became contaminated with deadly bacteria, including *E. coli* and *Campylobacter*. Seven people died, and more than 2300 became ill.

The outbreak was caused by many factors, including poor well location and geological factors that resulted in a well under the influence of surface water. There was a lack of understanding of why chlorine is used as a disinfectant and of the significance of finding *E. coli* and other coliform bacteria in potable water. There were unethical operational practices, and the Ontario Ministry of the Environment (MOE) regulatory inspection reports were routinely ignored.

Eventually, two town officials pleaded guilty to charges of common nuisance stemming from the contamination. But the lessons learned from Walkerton still provide valuable insights for water utilities.

System specifics

The Walkerton water system was operated by the Walkerton Public Utilities Commission (PUC), which used three wells to supply the system with groundwater. Two of the wells (6 and 7) supplied water from deep aquifers.

Chlorine was used for disinfection, but the water from the wells was so hard that PUC made plans in 1978 to develop a shallow well (Well 5), which held the promise of softer water. Well 5 was placed in a wet area, virtually a swamp, with permeable soil, fractured limestone underneath, and springs in the vicinity.

Work on drilling and developing the well began before MOE approved the project. After the well was drilled and developed, Walkerton applied for the well's approval. The hydrogeological report sent to MOE noted that water coming from the new well contained total and fecal coliform. It described the well location's thin soils, the potential of surface contamination, and how pumping Well 5 caused local springs to stop flowing. The presence of total and fecal coliforms in the well water immediately raised concerns about contaminated surface water.

Ultimately, MOE temporarily approved the well but required Walkerton to adhere to certain conditions. Walkerton was required to pursue a new, more protected supply of softer water, and Well 5 would be removed from service once a new well was identified. MOE also recommended that Walkerton purchase adjacent land and adopt watershed controls for local adjoining properties.

To allow the well's use, water from Well 5 was to be disinfected in such a manner that a free chlorine residual of 0.5 mg/L would exist in the water after 15 minutes of contact time. Conditions also included the installation and operation of an online chlorine residual meter and turbidimeter. The Walkerton PUC agreed its staff would monitor chlorine residuals daily and record the results in daily operating sheets.

However, as time went on, many of these conditions were never met. A location for a well to replace Well 5 was never

Walkerton's drinking water system became contaminated with deadly bacteria, including E. coli and Campylobacter. The outbreak was caused by many factors, including poor well location.

Left: Memorial dedicated to the people of Walkerton who suffered and those that died during the outbreak. Above: Well 5 plaque.; Well 5 was placed in a wet area, virtually a swamp, with permeable soil, fractured limestone underneath, and springs in the vicinity.

identified, adjacent lands were never purchased, and no water-shed controls for local property were ever adopted.

Moreover, residual chlorine meters and turbidimeters were never purchased, the regulatory agency never enforced the approval conditions, and chlorination of the water from the Walkerton wells was haphazard at best.

A catastrophe in the making

The use of a well under the influence of surface water set the stage for the events that occurred in 2000. The spring started with a farmer on neighbouring property doing what had always been done.

After winter broke in Ontario, manure stockpiled from the winter was routinely spread on a field near Well 5. That was followed about two weeks later by a period of torrential rainfall. During a five-day period from May 8–12, five inches of rain fell. Nearly three inches fell on Friday, May 12, alone.

During this time, Well 5 was pumping water into the town's system that originated from the shallow aquifer underlying the adjoining property.

On Saturday, May 13, an operator visited the well in service: Well 5. However, he didn't perform a chlorine residual check. The chlorinator was operative but set at a low dosage to minimise customer complaints of "too much chlorine."

However, too little chlorine meant inadequate disinfection. Water passing from Well 5 was laden with *E. coli* and *Campylobacter*, overwhelming the added chlorine. By not measuring the chlorine residual, the operator missed the opportunity to assess the residual and adjust the chlorine dose accordingly. Correcting the chlorinator at that time wouldn't have eliminated the outbreak, but it would have minimised the illness suffered by the community.

On Monday, May 15, routine samples from the Walkerton distribution system as well as samples from a new water main project were collected and submitted to a laboratory for bacteriological analysis.

The results were received two days later. All samples showed total and faecal coliform growth. Although the laboratory faxed this information to the Walkerton PUC, it was never relayed to the health unit, which was customary (although not legally required) at the time.

On Thursday, May 18, the first indications of widespread illness appeared in the community. There were many absences from the local school, and the local hospital began to see patients who showed symptoms of stomach pain, nausea, and bloody diarrhea. People started calling the Walkerton PUC to see if the water was safe. Within a day, the extent of illness drew the local health unit into the situation.

One of the first things the health unit did was to contact the Walkerton PUC to verify the local water supply was safe.

Several times during the next few days, the Walkerton PUC told the health unit that the water was 'OK', with no mention that distribution samples taken earlier that week showed total and fecal coliform contamination. Alarmed by the situation, Walkerton's general manager told the Water Department's foreman to immediately install a chlorinator on Well 7, after which the well was brought into service to deliver a high chlorine residual into the water. Then the distribution system was extensively flushed.

As more people reported to the hospital, a full investigation into the water system was under way. The puzzle began to be solved when a child's stool specimen tested positive for *E. coli* O157:H7, a potentially fatal strain. The bacteria's toxin enters the bloodstream and causes blood cells to clump, leading to haemolytic uremic syndrome (HUS). The kidneys can shut down without dialysis, and death will follow.

By May 21, the health unit had been trying to determine the outbreak's cause. Despite being told there were no problems with the water, health unit staff collected their own series of bacteriological samples and delivered them to a regional lab for analysis. And with more people reporting to the hospital, stool specimens testing positive for *E. coli*, and the health unit being unable to identify the source, a boil-water order was issued.

In the following days, several children were airlifted to medical centres for HUS treatment, many more Walkerton residents were hospitalised, and *E. coli* was confirmed in numerous bloody stool specimens. Eventually, the distribution system water samples collected by MOE on May 21 tested positive for total and faecal coliform, and the complete story emerged. Walkerton then set about restoring proper water quality, but the boil-water order wasn't lifted until December 5. The outbreak's final toll was 2300 people ill, seven deaths, and an economic impact of approximately $155 million.

Lessons learned

Several factors contributed to the outbreak. The spreading of cattle manure in the field adjacent to Well 5 introduced contamination into the local aquifer. Rain beat the manure into and through the shallow, porous soils, where it encountered fractured bedrock.

Contaminated water then flowed into Well 5, where the low chlorine dosage was insufficient to inactivate the microbiological contamination in the water. DNA tests revealed the *E. coli* specimens in the manure were identical to the *E. coli* in the stool specimens of the ill. The contamination's source had been found.

If Walkerton's water treatment operators had performed chlorine residual analyses and understood the significance of maintaining a chlorine residual, the number of illnesses in the community would have been dramatically reduced. Comparing chlorine dosage and chlorine residual provides an operator with one piece of important information: chlorine demand.

With no changes in chlorine dosage, a rise in chlorine demand will cause the chlorine residual to fall. Disinfection efficiency is reduced as the residual falls, making it more likely that contamination will move through the treatment plant and into the distribution system.

To combat this scenario, additional chlorine needs to be added to the process to regain the desired residual. No matter how routine or repetitive it may seem, performing a simple chlorine residual check is the best real-time means by which an operator can ensure the water leaving the treatment plant is safe and of potable quality.

The Walkerton catastrophe reinforces how a community's residents can potentially develop significant and sometimes fatal health issues when water operators fail to understand their jobs and properly perform important tasks to protect public health. Nowadays, when many emerging contaminants often garner the headlines, it's important to remember the bacteria and other microbes that can sicken and sometimes kill us.

After 20 years, we can't forget Walkerton.

Renovate sewer rising mains

The renovation of sewer rising mains is often delicate and is why operators now look for trenchless rehabilitation methods. One of them is Primus Line.

Many sewer rising mains have several things in common: they are a critical asset to the asset owner, as it is often complicated to divert the flow for an extended period of time.

The accessibility to the pipe is mostly difficult, as the mains run through densely populated or environmentally sensitive areas or under creeks and main roads. The pipelines often have several bends in the run of the main. Faulty sewer rising mains have the potential to cause pollution, damage property and neighbouring services, resulting in significant costs.

Failures on rising mains can be caused by external corrosion, internal corrosion or mechanical failures like leaking joints, longitudinal cracks, etc. In many cases the pipeline is still able to withstand the traffic loads, but not the internal pressure loads.

A renovation using sewage lining or slipining with HDPE is often not acceptable due to the significant diameter reduction, the limitation of installing through bends, the pit sizes and the duration of the installation.

The Primus Line system, engineered and made in Germany, offers a solution for this extraordinarily difficult scope. The system consists of a flexible Kevlar-reinforced liner and special end fittings.

Primus Line has a small installation footprint, a wall thickness of only six millimetres, the flexibility to be installed through consecutive bends, the possibility to reline 500 metres and more in only one day, and achieve installations shots, pit to pit, of 1000 metres and more.

In addition, Primus Line is installed with an annulus, so the installed liner will accommodate the operating pressure and will release the host pipe from bearing the internal forces, and therefore stop the aging process of the existing main caused by the operational loads and internal corrosion.

The Primus Liner is a factory-tested product, that comes on a transport reel to the construction site. After CCTVing and cleaning the existing main, the pre-folded liner is winched in position and inflated using only compressed air. Subsequently, the line connectors are installed and a pressure test completes the installation process.

Tried and tested technology

The Primus Line system has already proved its suitability for rising mains in numerous installations in Australia, and the renovation of a DN600 sewer trunk main for the City of Gold Coast has been awarded the 'ASTT Rehabilitation Project Of The Year 2019'.

For Sydney Water, Primus Line also relined over 100 metres of a vertical sewer main in one of its treatment plants. The combination of strength and flexibility of the Kevlar fabric, the high safety factors on the material and the extended asset lifetime of 50 years and more make its a perfect fit for the rehabilitation of sewer rising mains.

The small installation footprint is small. Installation of 800 metres DN 300 Primus Line in a sewer rising main though an existing maintenance chamber. Primus Line can also be used to renovate vertical pipelines.

Ground water testing data now online

LAWA (Land, Air, Water Aotearoa) has released a new online topic that shows the quality of our vital underground water resources. Its Groundwater Quality information online makes monitoring data from almost 800 wells publicly accessible.

LAWA is a partnership between 16 regional councils and unitary authorities, the Cawthron Institute, and the Ministry for the Environment, and with support from Department of Conservation and Statistics.

Environment Canterbury Scientist Carl Hanson is the LAWA Groundwater Quality topic Lead and says many people aren't aware of the importance of our groundwater resources despite the fact groundwater accounts for about 80 percent of all freshwater in New Zealand.

"Regional councils and unitary authorities are responsible for monitoring groundwater quality and their sampling results are now available on the LAWA website. Looking at the data, most of our groundwater is of very good quality. However, contamination from *E. coli* and nitrate does occur in some wells and there are longer-term trends of degrading water quality in some areas.

"An important message to take away is that anyone using groundwater as a source of drinking water should make sure their well is sealed and have their water tested regularly," says Hanson.

Horizons Regional Council Groundwater scientist Abby Matthews says; "On the LAWA website, visitors can see state and trend info for groundwater sites on an interactive national map.

"Site state and trend have been evaluated for five widely recognised indicators of groundwater quality; these indicators are *E. coli,* nitrate, phosphorous, chloride, and electrical conductivity. Together they provide insight to the presence of pathogens, nutrients, and seawater intrusion."

Regional council and unitary authority staff regularly collect groundwater samples from across their regions following rigorous procedures, before sending the samples for testing by accredited laboratories.

Doug Leeder, the chair of Local Government New Zealand Regional Sector and Bay of Plenty Regional Council, says by making our monitoring data accessible on the LAWA website we can raise the profile of groundwater and equip the community, scientists, policy-makers, and industry with a useful resource.

The LAWA Groundwater Quality topic features state and trend information for individual sites, and factsheets, videos, and a glossary to assist with interpretation.

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