WATER

Issue 177. November 2012

AMAzing Water Quality Improvements

No Single Way to Engage with Communities

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

"in the know about water flow"

METERING

SENSUS METERING SYSTEMS

Meinecke Bulk meters

Flow, pressure, time data logging

Socam 620 Domestic/Commercial meters

Also:

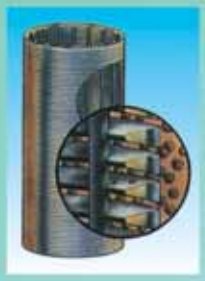
- Electronic meters
- Manifold meters
- Apartment meters
- Irrigation meters
- Combination meters
- Remote meter reading and interface electronics

FILTRATION

ARKAL FILTRATION SYSTEMS

Johnson screens

Auto disc municipal filter batteries



Vee wire well process & intake screens

Passive intake screens

Also:

- Water and effluent manual disc filters
- Auto disc effluent filter batteries

CONTROL

BERMAD

WILKINS A ZURN COMPANY

VENT-O-MAT®

Pipeline Anti surge air valves

Backflow preventers

Sewage Air and vacuum valves

Hydraulic control valves

Also:

- Safety valves
- Air & vacuum valves
- Fire protection and petroleum control valves

. . . we listen. . . we advise. . .we deliver

Deeco

Deeco Services Ltd

Facsimile: 0800 333 267 • Email: service@deeco.co.nz • www.deeco.co.nz

***Tel: 0800 4 DEECO** (0800 433 326)*

AUCKLAND WELLINGTON CHRISTCHURCH

Established in 1938 DEECO is a NZ owned and operated business. Over time DEECO has amassed a wealth of knowledge relating to the needs of the water services industry.

Representing leading manufacturers DEECO can provide a high level of experience and support to NZ industry, consultants, engineers, IQP's, watermain contractors and plumbers.

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

WATER

Postal: PO Box 1316, Wellington 6140
Level 12, Greenock House,
39 The Terrace, Wellington, 6011
P +64 4 472 8925, F +64 4 472 8926
enquiries@waternz.org.nz
www.waternz.org.nz

WATER JOURNAL
Editorial/Writer: Robert Brewer, robert@avenues.co.nz
Advertising Sales: Noeline Strange, P +64 9 528 8009, M +64 27 207 6511, n.strange@xtra.co.nz
Articles: To contribute to future issues please contact Robert Brewer at Avenues, robert@avenues.co.nz, P +64 4 473 8054
Design: Leyla Davidson, Avenues, Level 1, 56 Victoria Street, PO Box 10–612, Wellington, P +64 4 473 8044
www.avenues.co.nz
Distribution: Hannah Smith, P +64 4 495 0897,
ISSN 1177–1313

The next issue of *WATER* will be published in March 2013.

On the Cover

Water New Zealand News

Features and Articles

Cover photo: Tracey Robinson Photography

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.

Steve Couper

What is Our Purpose?

Who are we and what are we trying to achieve? What is the purpose of our organisation and who do we represent? Should we be advocating for any particular outcome or are we simple technical folk who shouldn't have an opinion and accept the status quo?

These questions that many of us on the *Water New Zealand* Board have toyed with over the past few years have significant relevance given the potential for change facing our sector over the next couple of years.

I have not worked as an employee for a TLA or utility organisation in this country, but I have been involved in numerous projects as an advisor to local authorities and water utilities and what I can tell you for certain is that people make the difference. And our sector is full of good, passionate people that care about delivering excellent services to customers.

This group of hard working professionals and their associated delivery of urban water services to our cities and towns in New Zealand needs more recognition. Our work while often not the most glamorous in the infrastructure space is vital to our society, often not appreciated and undertaken in a financially constrained environment.

I therefore see a role for *Water New Zealand* to lift our sector profile in the eyes of those who make the big decisions. To do this we need to highlight what we do now (with the limited resources made available to us), and what we could do better given half the chance.

"I have not worked as an employee for a TLA or utility organisation in this country, but I have been involved in numerous projects as an advisor to local authorities and water utilities and what I can tell you for certain is that people make the difference."

This does not necessarily mean wholesale change, and it certainly does not mean that our people are not performing as best they can given the current organisational frameworks and resources available to them. Quite the contrary, I consistently see examples of innovation and excellence in service delivery across our sector because people that care have gone the extra mile. However, to continue to lift our game, we also need to question the status quo; this is how we identify improvements in any system or framework.

Over the next 12 months the Board would like to work with other organisations that also have representation across the New Zealand water sector and want to lift our sector profile. We would like to find areas of common interest and alignment and to openly debate any areas where there are differences of opinion so that we can look to find common goals.

If we can agree on some of the basic principles for water service delivery, then as a common voice, we are more likely to get the recognition we deserve and outcomes that are favourable for our sector.

Please provide your feedback to the Board on any matters that you would like discuss or bring to our attention. You can do this by sending an email to *Water New Zealand* addressed to me or any of the Board members.

Finally – thank you to all of you who attended the annual conference. I hope you enjoyed the technical programme and the exhibition, it is an important part of the year and provides for excellent networking and discussion opportunities. It is these opportunities and others like them that will also be a key focus of *Water New Zealand* over the coming year, in particular further networking opportunities and an additional technical focus to members.

We look forward to seeing you all again in Hamilton next year. ■

Steve Couper
President, Water New Zealand

"...I consistently see examples of innovation and excellence in service delivery across our sector because people that care have gone the extra mile."

new members

Water New Zealand welcomes the following new members:

KARAMJEET SAINI
JOHN MCCARTIN
ROB GREEN
JENNY WARREN
ADRIAN TONKS
JOEL DYKSTRA
CLAIR PERKINS
ANNIE FENG
MARC CIOCHETTO
RICHARD PARKINSON
CHRISTINE BYRNE
DAVID HEILER
IAIN PARTINGTON
REUBEN BOUMAN
ULRICH KORNMUELLER
MURRAY KERR
IAN MACBETH
REBECCA BIBBY
CLAIRE SIMS
MIKE LAW
GRAEME JENNER
ANDREA HORTON
GHIDA SINAWI
BRUCE LEVIEN
SIMON MASON
MIKE FRANCIS
MIKE HUXTABLE
WIOLETTA STRASZAK
NIHAL GINIGE
GUY DENNIS
HAJARI THAKUR
JAYESH DHANJEE
CHERYL BAI
ZAB DOST
ZEB WORTH
ROBERT GORDON
AVEEN SINGH
JAMES REDDISH
NATHAN HUGHES
CRAIG MOUNTJOY
STEPHEN WHYTE
DAVID ALDERTON
ROSS KERTON
MANU WARD
MONA LIAO
FIONA VESSEY
WARREN MACKRELL
WARREN LADBROOK
NICOLA MALLOCH
DARYN JEMMETT
DESIRAE KIRBY

Murray Gibb

"Getting the balance right between advocacy and other objectives is the challenge. Partially in order to do so, a position was recently created to improve *Water New Zealand's* technical output. Historically *Water New Zealand* has been strong in servicing the technical needs of members. Amongst other things, that includes contributing to the development of standards. That benefits both members and society at large."

Advocacy and *Water New Zealand*

Since 2007 *Water New Zealand* has stepped up its advocacy activity, something not all are comfortable with. The Association's advocacy for reform of water governance arrangements has created some friction.

This raises the question of *Water New Zealand's* role in society. Should the Association be in the business of advocacy?

Our constitution sets out the purpose and objectives of the Association. The purpose statement is quite clear. *It is 'to be the pre-eminent organisation in New Zealand for promoting and enabling the sustainable management and development of the water environment.'*

Four objectives sit under the purpose statement.

The first is strategic, *'to promote integrated national and regional policies in the water environment based on sound principles and knowledge.'*

The second is service, *'to facilitate the exchange of knowledge and provide quality products and services to meet the needs of our members.'*

The third is societal, *'to benefit society by promoting a better understanding of the water environment and the sustainable management and development of resources, and to provide leadership and informed advocacy on water and wastes.'*

The fourth is technical, *'to promote the advancement and application of fundamental knowledge to natural water resources, water use and the environment.'*

In 2006 NZWWA surveyed members to find out what they thought of the Association and the services it was providing. To quote from an analysis of the survey, *"there is solid support for the Association taking a clear leadership role in facilitating the development of the wider water environment and in promoting the profile of the water industry; in fact, this is seen as the top priority for the Association. Although there is also recognition of the difficulties in tackling this task – including the diversity of membership interests and the absence of a unified, definable 'water industry' – there can be no doubt of the strength of membership expectation that NZWWA should be leading the charge."*

Getting the balance right between advocacy and other objectives is the challenge. Partially in order to do so, a position was recently created to improve *Water New Zealand's* technical output.

Historically *Water New Zealand* has been strong in servicing the technical needs of members. Amongst other things, that includes contributing to the development of standards that benefit both members and society at large. With the specific knowledge and expertise that resides in their membership base on a national scale, organisations such as *Water New Zealand* have a dual role in society in promoting standards. In doing so we're practising good corporate citizenship.

We recognise we can do more in promoting standards, which come in all shapes and forms. These include our suite of guidelines, manuals, codes of practice, standards, educational booklets and other publications. From time to time members are also co-opted onto Standards New Zealand and other committees to contribute to the development of new, and revision of existing, national and international standards.

Currently, member Curt Martin sits on a committee updating *NZS 3910: 2003 Conditions of Contract for Building and Engineering Construction*. Another member, Brent Clothier, represents Water New Zealand on a group developing an ISO standard on water foot printing entitled *Water Footprint – Principles, Requirements and Guidelines*. Once developed, the latter should provide information on the sustainability of managing the water component of food production.

Individual members of *Water New Zealand* are drawn from across the total water industry and water environment. Our nationwide network of members represents many disciplines; physical and social sciences, public health, engineering, law and management. The Association attracts decision makers and technologists from central and local government, industry, the academic and research communities, consultants and service/equipment supply organisations, to exchange information about water and wastes issues.

Given the breadth and depth in this membership base and our associated networks we're therefore well placed to promote standards. It also places us well to provide informed advocacy on the water industry. Our constitution requires us to do so. ■

Murray Gibb
Chief Executive, Water New Zealand

LAST ISSUE OF *WATER* FOR 2012

This is the last issue of *WATER* for the year. Water New Zealand would like to thank all those who have taken the time to contribute articles, images and ideas over the past year.

The next issue will be in mailboxes mid-March 2013.

If you wish to contribute please contact the editor, Robert Brewer, on +64 4 473 8054 or email robert@avenues.co.nz

The themes and deadlines for the 2013 issues will be confirmed in December.

Another successful three days of Annual Conference played out at the Rotorua Events Centre from 26–28 September. Over 900 people, both conference attendees and expo personnel and visitors moved through the doors during the course of the conference and around 450 attended the Conference Dinner and Awards Ceremony.

This year we had speakers from Australia, the South Pacific, Denmark, the United Kingdom and, of course, New Zealand.

Further presentations on the Wednesday addressed topics such as the state of Australia's waterways, the clean-up process for the Waikato River, advanced new technologies for water manage ment, water and wastewater issues in South Pacific island states, and a health expert's view on the fluoride issue. A special feature was an after lunch keynote from Jamie Margetts, Vice Chair of WaPUG which is CIWEMS urban drainage special group. Jamie

"Over 900 people, both conference attendees and expo personnel and visitors moved through the doors during the course of the conference..."

Proceedings formally commenced on the Wednesday morning with a Powhiri from Te Arawa, followed by a welcome from His Worship the Mayor Kevin Winters that included a brief presentation highlighting some of the more innovative technologies employed in the clean-up of the area's iconic lakes.

The Conference proper started with a detailed and informative presentation from Denmark's Professor Torkil Jonch Clausen looking at the world's water resources and the energy demands that will arise as population increases and large urban conurbations multiply. Professor Clausen went on to discuss the concepts around Integrated Water Resources Management as means of addressing the myriad of water issues, including the food production challenges, minimising inefficient water use, land acquisitions and the politics of water.

gave an overview of the history and current state of the UK's water industry and discussed that country's experience with floods and urban drainage planning.

Thursday opened with a presentation from The Honourable Amy Adams, Minister for the Environment, who demonstrated both in her address and during question time a very good understanding of the spectrum of water issues. Subsequent presentations discussed reforms in Australia, the Christchurch recovery exercise, and the challenges presented in the restoration of the Rotorua lakes.

Alongside these presentations Wednesday and Thursday were full technical streams plus ASST, modelling and operations streams. All this kept our Technical Committee very busy but once again they did a superb job.

On Friday morning the AGM, an Exhibition Visitors' Morning, and a lively forum discussion on the state of our waterways, Science Fact or Science Fiction, were held.

The Conference was supported by a comprehensive exhibition and delegates enjoyed a range of social functions including the ABB Ltd Welcome Reception, the Innovyze Modelling Dinner, and the Allied Instruments Operations Dinner, all on the Wednesday evening. The social highlight of the Conference was the Dinner and Awards Ceremony on the Thursday evening when delegates were both entertained and able to acknowledge the success of their peers, in particular the recipients of the Hynds Paper of the Year Award.

Thanks go to all who supported the conference and in particular our premier sponsors CityCare, Downer, Hynds, Streat Control, Veolia Water, and Xylem.

Incoming President Steve Couper formerly closed the Conference on Friday and noted next year's Conference would be held at the Claudelands Events Centre in Hamilton, 16–18 October 2013.

Peter Whitehouse – Water New Zealand

"Thanks go to all who supported the conference and in particular our premier sponsors CityCare, Downer, Hynds, Streat Control, Veolia Water, and Xylem."

THANK YOU

We would like to thank the six premier sponsors for their continued support for *Water New Zealand's* Annual Conference & Expo.

We would like to thank the six representatives of these organisations pictured here at the Conference last month – from Left to right – Peter Gendle – Veolia Water, Wendy Gorrie – Hynds, Brian Bennett – Streat Control, Chris Wrathall – City Care, Judy Pollard – Downer and Tony Looker – Xylem.

Water New Zealand is grateful for their tangible support, advice and input in planning the Conference & Expo.

We are also appreciative of the generous support from the sponsors of our awards and social functions. Thanks to ABB Limited for supporting the Welcome Function, INNOVYZE for their support of the Modelling Dinner and similarly Applied Instruments Group supported the Operations Dinner as well as sponsoring the Coffee Cart, Internet Café and Wifi. Our Awards enjoy the support of CH2M Beca for the Young Water Professional of the Year Award, Opus for the Trainee of the Year Award, Orica Chemnet for the Operations Prize, AWT for the Poster Competition and Hynds for the Paper of the Year Award. ■

Water New Zealand Awards 2012

Congratulations to all *Water New Zealand* Award winners for 2012.

Orica Chemnet Operations Prize

Mathew Jamieson – Veolia Water, Thames Coromandel

AWT Poster of the Year Award

Sally Dymond – *The Sky, The Sea and Me. Improving the Connection Between Urban Populations and Their Three Waters*

Ronald Hicks Memorial Award

Paul Weber, Mark Pizey, Fiona Crombie, Glenn Rutter, Phil Lindsay, Dave Thomas, Don Elder, Joe Wildy, Tony Cooper and Phil Rossiter of Solid Energy – *Addressing the Environmental Effects of Mining on the Ngakawau River*

Technical Committee

Dukessa Blackburn-Huettner, Rebecca Fox, Steve Apeldoorn, Rob Blakemore, Neal Borrie, Ashish Deshpande, Louis DuPreez, Ian Garside, Roly Hayes, Kelvin Hill, Sarah Lothman, Rob Murray, Victor Mthamo, Kees Swanink, Louise Weaver, Wendy Williamson and Chris Wium

Opus Trainee of the Year Award

Mathew Jamieson – Veolia Water, Thames Coromandel

CH2M Beca Young Water Professional of the Year Award

Dr Annie Feng – MWH Global (see story in Commercial News)

Hynds Paper of the Year Award

Gold: Peter Browne – *Overcoming Rotorua Lakes Ecological Challenges*

Silver: Fiona Crombie – *Passive Treatment of Acid Mine Drainage Using Waste Mussel Shell, Stockton Coal Mine, New Zealand*

Bronze: Martin Evans – *One of a Kind – Challenges in Setting Performance Criteria for a DBO Contract to Procure Wastewater Treatment and Disposal at Maketu, Bay of Plenty*

Exhibitors – Best Stand Award

Best Stand: HydroTech Drainage

Highly Commended: Pipe & Infrastructure Limited and MacEwans Pumping Systems Limited

Other Awards

Modelling SIG Best Paper Award

Jonathan Church – *Evaluating and Optimising the performance of Chlorine Contact Tanks Using CFD*

AIRVAC is as committed to our products as we are to our customers.

At the heart of every AIRVAC Vacuum Sewer System is the vacuum interface valve shown above. The development of this technology has made the advantages and flexibility of vacuum liquid conveyance possible. Although this valve represents our latest technology, many of our first valves are still in operation today.

Today, most products are disposable and designed to have built-in short life cycle limits. Not at AIRVAC. We have been working nearly 40 years to develop products that are more reliable and last longer. We understand choosing an AIRVAC vacuum sewer system requires a lifetime commitment from you. More importantly, it demands a lifetime commitment from us. AIRVAC is focused not only on making superior products, but also on developing full-service, long-term customer relationships. We do this by providing support and service every step of the way including assistance with the planning, design, construction and operation of your vacuum sewer system.

We are developing our technology and our relationships to last a lifetime.

Go to airvac.com to learn more about AIRVAC support and services.

MacEwans Pumping Systems Ltd.:
19 Ride Way, North Harbour Industrial Estate, Auckland
Tel: 0-9-415 4860 0800 pumping (7867464)
Email: alan@macewans.co.nz or pumps-ak@macewans.co.nz

Corporate Office:
4217 N. Old U.S. 31, Rochester, IN USA 46975 • Tel: (574) 223-3980

THE economical and ecological wastewater collection system.

AIRVAC®

The World Leader in Vacuum Sewer Technology

MacEwans

MacEwans Pumping Systems Ltd

Third Recipient of the *Water New Zealand* Association Medal

The Association Medal is awarded at the discretion of the *Water New Zealand* Board to a New Zealand citizen who has made an outstanding contribution to the water industry and the Association within their life.

In order to retain its exclusivity and esteem, there are only a very limited number of living holders at any one time. It has only been awarded twice. At the 2012 Annual Conference & Expo, Public Health Engineer, Ian Gunn, became the third recipient of the Association Medal.

Ian Gunn has made a distinguished contribution over a long career to the betterment of wastewater management both locally and internationally. He is acknowledged as a world leader in on-site wastewater treatment and disposal.

Graduating as an engineer in 1958 he spent the next 11 years in wastewater engineering in New Zealand, Australia and in the United Kingdom. In 1969 he commenced a 29 year academic career at Auckland University's School of Engineering, with responsibilities for teaching environmental management, resource management and water, wastewater and solid waste engineering.

"As an academic he was an outstanding teacher, training a generation of undergraduate engineers in his chosen discipline, supervising numerous post graduate students while undertaking an extensive research programme... He consolidated the science and application of localised wastewater treatment and disposal, an unglamorous area of engineering which he pursued with real skill and passion."

As an academic he was an outstanding teacher, training a generation of undergraduate engineers in his chosen discipline, supervising numerous post graduate students while undertaking an extensive research programme. He consolidated the science and application of localised wastewater treatment and disposal, an unglamorous area of engineering which he pursued with real skill and passion.

Following his 'retirement' from the University he set up an environmental engineering consultancy business. He continues with a full workload of consultancy advice both in a professional and voluntary capacity, 55 years after graduating.

Through the University, and voluntarily on his own account, he provided expert professional advice to numerous communities throughout New Zealand struggling to upgrade their wastewater services. Through his extension work the management of these point sources of water pollution has been significantly improved over the past five decades.

In 2007–08 he led a project to develop a national facility in Rotorua for testing small wastewater treatment systems. A catalyst for this activity was the detrimental effect poorly performing systems had on surface water quality, particularly in New Zealand's iconic lakes, such as those in the Rotorua area.

For 50 years he has contributed significantly to the national representative bodies covering water and wastewater management. He instigated the Auckland Combined Water Group. This led to national amalgamation of the two parent organisations in 1992 to form the *New Zealand Water and Wastes Association*, the predecessor of *Water New Zealand*.

He was the driving force behind the formation of *Water New Zealand*'s Small Wastewater and Natural Systems Special Interest Group (SWANS), and served as its chairman for an extended period.

In recognition of his many services to these organisations and to the industry, he has been elected an Honorary Member of *Water New Zealand* and a Fellow of the Institution of Professional Engineers New Zealand.

His skill as a communicator was recognised in 1998 when he was awarded the IPENZ Communications Award, for outstanding achievement in communicating engineering and the work of engineers to the media and the public.

His influence has led to major innovations and improvement in the performance of wastewater treatment, with consequent flow-on benefits to human health and the environment. He commands widespread respect as a passionate civil engineer, teacher and researcher. ■

Announcements

2012 – 2013 *Water New Zealand Board*

Congratulations to Dukessa Blackburn-Huettner for her election on to the Board and to Mark Bourne for his re-election.

The 2012/2013 Board is:

- Steve Couper – President
- Hugh Blake-Manson
- Rob Blakemore
- Mark Bourne
- Brent Manning
- Dukessa Blackburn-Huettner

Co-opted Members:

- Adrian Hynds
- David Hill

WATER NEW ZEALAND'S
8TH SOUTH PACIFIC STORMWATER CONFERENCE

STORM WATER 2013

8–10 MAY
AUCKLAND

The Conference Committee is currently in the planning stages of the Stormwater Conference for 2013. The conference will be held from 8 – 10 May at the Rendezvous Hotel in Auckland.

Registration

Registration opens Thursday 14 February 2013 – register early to enjoy significant discounts with early bird rates.

Programme

The programme will be published in December 2012 at www.waternz.org.nz

Sponsorship and Trade Exhibition

The Stormwater Conference is a prime opportunity to promote your organisation through sponsorship and the trade exhibition. See the Sponsorship Opportunities listed opposite for what's on offer.

For further details on the sponsorship and exhibition opportunities available visit www.waternz.org.nz or email Bronwyn Carson, Event Manager – bronwyn@avenues.co.nz

Sponsorship Opportunites

PREMIER SPONSORSHIP
One opportunity available
Total Investment Required –
$10,000 + GST

CONFERENCE PARTNER
Three opportunities available
Total Investment Required –
$5,000 + GST

INDUSTRY SUPPORTER
Total Investment Required –
$3,000 + GST

ADDITIONAL SPONSORSHIP OPPORTUNITIES

- Conference Dinner & Social Hour
  $5,000 + GST
- Welcome Cocktail Function
  $2,500 + GST – plus coffee costs
- Internet Café, Wifi & Coffee Cart
  $2,500 + GST
- Keynote Sponsorship
  $2,500 + GST plus associated costs

CIWEM in New Zealand

Dan Stevens – Water Asset Management Leader, Opus International Consultants Ltd

In his President's Column in the May issue of Water, Clive Rundle raised the question as to whether the water industry in New Zealand should start to think about aligning with international organisations such as CIWEM, which would offer water and environmental professionals here a wider range of opportunities to reach chartered status. Many readers of that column will not have heard of CIWEM before and this article provides some details about the organisation and the recent development of a CIWEM Country Network in New Zealand.

CIWEM – A Brief History

CIWEM (The Chartered Institution of Water and Environmental Management) has a history of working in environmental management dating back to 1895. In the succeeding decades, engineers, scientists and other professionals came together to combine their expertise across a broad range of environmental disciplines. The present day Institution is based in the UK and was formed in 1987 when the Institution of Public Health Engineers merged with the Institution of Water Engineers and Scientists and the Institute of Water Pollution Control to form the Institution of Water and Environmental Management.

The Institution was granted a Royal Charter in 1995 and was proud to celebrate its centenary in the same year. Working for the public benefit for a clean, green and sustainable world, CIWEM is the only independent, chartered professional body and registered charity with an integrated approach to environmental, social and cultural issues.

CIWEM Internationally

CIWEM is an international organisation with a membership base stretching over more than 90 countries and connecting a network of over 15,000 professionals worldwide. CIWEM provides input into the UN Framework Convention on Climate Change, supports training initiatives for professionals across the world, develops agreements with learned societies in other countries and looks to further global environmental knowledge exchange. CIWEM also helps to shape European policy by representing the European Water Association on steering groups under the Water Framework Directive.

The Institution's future aims include strengthening the links between members in each country; further internationalising existing panels, groups and networks; developing more strategic partnerships across the world; supporting the growth of professionals in the sector and campaigning on key global water, sanitation, climate and environmental issues.

CIWEM New Zealand Country Network

Until now there has been little in the way of formal support for the almost 100 New Zealand based CIWEM members. Recently a group of CIWEM members, with backing and approval from CIWEM Senior Executives, formed a "Country Network" for New Zealand. A Steering Group was formed with seven representatives from a variety of organisations and disciplines. This group includes:

- David Ward and Stephanie May (Watercare)
- Charlotte Reed (Tonkin & Taylor)
- Shaun Hodson (HydroTech)
- Dan Stevens (Opus)
- Jonathan Reed (Beca)
- Pete Brooks (GreensceneNZ)

The CIWEM team in New Zealand have developed some broad objectives. These are:

- To communicate with and support CIWEM members in New Zealand
- To deliver a number of high quality, informative local events that enable people to engage and learn from other water / environmental professionals
- To mentor and develop water and environmental professionals to enable them to reach chartered status – Chartered Water and Environmental Manager (CWEM), Chartered Environmentalist (CEnv), Chartered Scientist (CSci) or Chartered Engineer (CEng)
- To be actively engaged in matters which benefit New Zealand's water and environmental well being

> "CIWEM (The Chartered Institution of Water and Environmental Management) has a history of working in environmental management dating back to 1895."

CIWEM has a broad remit across water and the environment and perhaps the biggest single benefit that CIWEM offers to professionals in New Zealand is that this provides an opportunity to achieve chartered status from a range of environmental and scientific disciplines. In addition to CIWEM's own CWEM qualification, CEnv is offered through the Society for the Environment (UK), CSci through the Science Council (UK) and CEng through the Engineering Council (UK).

The Steering Group have been in discussions regarding informal partnering arrangements with *Water New Zealand* and EIANZ with the aim of promoting:

- Joint local events or evening meetings about environmental issues
- Providing opportunities for non engineers to follow a training scheme and obtain a professional qualification
- Providing access to the global CIWEM network

The CIWEM New Zealand members held their inaugural evening meeting in Auckland on 18 July which was attended by 30 people. The event featured two excellent and timely presentations by CIWEM NZ members Jonathan Reed and James Reddish. Jonathan gave a fascinating presentation on the river restoration and habitat creation within the London Olympic Park, and James gave an insight into the flood risk and spatial planning works associated with the London 2012 Olympics. Both presentations stimulated some interesting debate about how similar approaches could be applied in New Zealand.

It is hoped to hold other events later in the year in different locations across New Zealand.

How to Find Out More About CIWEM in New Zealand

If you would like to learn more you can visit the CIWEM website www.ciwem.org/knowledge-networks/country-networks/new-zealand or follow the CIWEM New Zealand Country Network on Linked-In.

For further details contact the CIWEM New Zealand Chair of the Country Network Steering Group David Ward Tel: 09 539 7409 or email dward@water.co.nz or contact any of the other Steering Group members. ■

National Fluoridation Information Service (NFIS)

Information supplied by Kathie McCarten – Communications Coordinator, Technical Support, Lower Hutt District Health Board

Who Are We?

The National Fluoridation Information Service (NFIS) is a consortium funded by the Ministry of Health. Led by Regional Public Health, it also includes the Hutt Valley DHB Community Dental Services, Environmental Science and Research, Centre for Public Health Research at Massey University and the National Poisons Centre.

There is ongoing research and monitoring around the world looking at the effectiveness and safety of water fluoridation programmes. NFIS has been established to monitor and assess this work and to provide technical advice on these issues. NFIS offers robust and independent scientific and technical information around water fluoridation to District Health Boards (DHBs) and Territorial Local Authorities (TLAs).

What is Our Role?

- Provide a central authoritative, accurate and up-to-date source of information and critical commentary on research pertaining to water fluoridation
- Provide coordinated clinical and technical support and advice to DHBs, TLAs and the Ministry
- Ensure DHBs and the Ministry are able to communicate consistent, accurate and up to date information on water fluoridation
- Follow public discussion and decision making on water fluoridation

What Do We Do?

- Provide a centralised website portal to data and research on dental health and water fluoridation in New Zealand
- Provide up to date critical review of emerging research related to water fluoridation
- Share information via quarterly e-newsletters and e-briefings
- Support local health authorities to provide clinical and technical advice to DHBs and TLAs around water fluoridation

How Do I Access the Service?

For information, support or advice please email the National Fluoridation Information Service Coordinator: nfis@huttvalleydhb.org.nz

Keeping Informed

To join our mailing list to receive newsletters, e-briefings or to share information about your experience or resources with others, please contact us via email: nfis@huttvalleydhb.org.nz

NFIS Documents

All documents completed by our consortium are posted on our website: www.nfis.org.nz and are available in PDF format. There is a quick link to our *On Tap* newsletters as well as all our planning documents, advisories, and reports and reviews.

Some of the documents and advisories available include:

Review of Scientific Papers Dec 2010 – August 2011
A systematic review on new scientific papers relating to community water fluoridation in the New Zealand context published between December 2010 – August 2011.

Environmental Scan
This document provides a summary of fluoridation activity in New Zealand in the past 12 months up until 31st March 2012

Baseline Evaluation for NFIS
This paper reports on the results of a survey of health officials' knowledge, attitudes and confidence in relation to dealing with fluoridation related matters

What Do We Mean By Evidence?
An article explaining what evidence is in a scientific context, for those with a non-science background

Domestic Fluoride Removal
Information about how different household water treatment systems for fluoride removal work

US EPA Guidelines Plain English Summary
Plain English summary of the review of the US EPA Guidelines Value for fluoride and drinking water

Newly Proposed US EPA Guidelines 2011
Review of the Newly Proposed US EPA Guidelines Value for Fluoride and Drinking Water

Fluoride Neurotoxicity
Review of evidence from drinking water studies

Delayed Tooth Eruption
Review of the evidence – Does Delayed Tooth Eruption Negate the Effect of Water Fluoridation

Centre for Human Statistics Data Brief No.53
Review of the Centre for Human Statistics Data Brief No. 53

Frequently Asked Questions

Over the past few months we have been working on creating brief answers to frequently asked questions. The answers are written in plain English and provide a response that you can easily share with others. Answers to questions below can be found on our website:

- Do lower levels of fluoride protect my teeth?
- Does fluoride just stop the holes in my teeth? Or does it help rebuild my teeth?
- How do water filters remove fluoride?
- How much fluoride is toxic?
- I have heard that fluoride gets into my saliva. What does it do?
- Levels of fluoride in our drinking-water
- What does fluoride do to plaque?
- What is fluoride?
- What levels of fluoride are in fluoride treatments at my dentist?
- What levels of fluoride are in toothpaste?
- What's in our drinking water?
- Why put fluoride in water?

Fast Facts

We have also produced a series of 'fast facts' for, among other things, what is in our water –

- Raw water, or water in its natural state, contains a variety of chemicals which it absorbs from the land it flows over and through. Some of these can be harmful to humans if consumed at high levels.
- The levels of a variety of naturally occurring chemicals in water are monitored by water suppliers to ensure that your water will be safe to drink. Any potential new water source is screened for a number of possible naturally occurring chemicals (MOH 2008).
- Methods to improve the taste and odour of drinking water were recorded as early as 4000 B.C. using treatment methods such as filtering through charcoal, straining and boiling. The Egyptians reportedly used the chemical alum as early as 1500 B.C. to remove particles from water. Filtration was commonly used in the 1700–1800s to make water appear less cloudy.
- It wasn't until the 1800s that scientists began to understand the sources and effects of drinking water contaminants that were not visible to the naked eye, such as cholera, typhoid and dysentery. By the early 1900s disinfectants like chlorine played a large role in reducing water borne diseases. In recent history other contaminants have been identified such as industrial and agricultural sources, and treatment processes continue to be developed to improve water quality (EPA 2000).
- Today the type of treatment process used, and the type and quality of source water determines what may be added to the water. Poor quality raw water requires a greater degree of treatment than good quality raw water.
- Some treatment plants may use ultra violet light, others add a small addition of one or two chemicals such as lime or chlorine, or there may be several additions to the water depending on the amount of organic matter, and its look, taste, and smell.
- Another factor in the treatment process is consideration of the metalwork used for plumbing. If the water source has a low pH, sometimes called 'soft water', it can increase the likelihood of corrosion of metals in the water pipes. A substance can be added that reduces the pH of water lessening the likelihood of metals in the drinking-water (MOH 2008).
- The most predominant source of drinking-water contamination in New Zealand is microbial. The Drinking Water Standards for New Zealand acknowledge that it is possible for chemical contamination to occur and they have a method of measuring chemicals against acceptable levels (called the MAV – maximum acceptable value). It is recognised that there is naturally occurring arsenic in the Central Plateau so there is a program in place to monitor this.

For further information on the NFIS please phone +64 4 587 2815 or email NFIS@huttvalleydhb.org.nz

"There is ongoing research and monitoring around the world looking at the effectiveness and safety of water fluoridation programmes. NFIS has been established to monitor and assess this work and to provide technical advice on these issues."

References

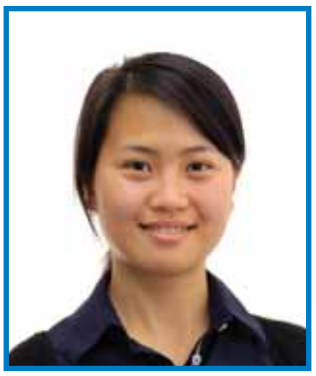
Chris Nokes ESR (Personal Communication) Natural Fluoride in NZ waters. 15/12/11

EPA (2000) The History of Drinking Water Treatment. Accessed from http://www.epa.gov/ogwdw/consumer/pdf/hist.pdf on 26/7/12

MOH (2008) Drinking-water Standards for New Zealand 2005 (Revised 2008).

A New Zealand Water Star is Born

Annie Feng, crowned Young Water Professional of the Year – MWH Global



Annie Feng

Nothing is going to rain on environmental engineer Annie Feng's excitement as she battled stiff competition to be crowned Young Water Professional of the Year 2012 by *Water New Zealand*.

The judges voted Annie the worthy winner having recognised her exceptional achievements and dedication to the New Zealand water industry at such an early stage in her career.

Since joining MWH Global in their Auckland Office in 2006, the 31 year-old has worked on a range of water and wastewater projects across New Zealand and Australia, for both government and industrial clients.

"Annie's dedication and hard work ethic at such a young age is clear. Whilst holding down her full-time job at MWH she achieved a Ph.D. in civil engineering from the University of Auckland last year. She has also published several papers and presented at conferences."

"I am most proud of the work I did for the Cambridge Wastewater Treatment Plant Consenting Project. Its success means a safer and improved wastewater treatment scheme for Cambridge which will help to protect the environmental and cultural values of the Waikato River. I was one of the main authors of the report and assessed the effects of the discharge of treated wastewater going to the river. This was a very rewarding experience as it allowed me to work on a large consenting project alongside some of the greatest people at MWH," says Annie.

This award recognises Annie's passion to improve the environmental landscape and the value she has added to the New Zealand water sector overall.

Annie's dedication and hard work ethic at such a young age is clear. Whilst holding down her full-time job at MWH she achieved a Ph.D. in civil engineering from the University of Auckland last year. She has also published several papers and presented at conferences.

Annie's ambition doesn't stop there though, she says, "I am delighted to have won but I am now looking to the future and would love to work on some of the really big projects at MWH Global and learn more from the teams about the finer skills of Building a Better World."

Annie is also the Auckland Young Professionals Group coordinator for MWH. Her role has seen her successfully bring together thirty staff members to take part in a Habitat for Humanity effort and build 11 homes in Otara, Auckland for those most in need. ■

Fiona stands by while the Tahuna outfall pipeline strings are manoeuvred onto the trestle

All in a Day's Work! Women Wow in the Water Industry

Anna Lindsay – Communications Advisor, AgITO

People of all ages and skill levels are employed in the water industry. In fact right now, men and women aged from 16 up to 70 are working towards a range of Water Industry Training qualifications to further their knowledge and experience.

"Water Industry Training currently has about 70 active women trainees studying towards a range of qualifications from the National Certificate in Wastewater Treatment to the National Diploma in Drinking Water – Drinking Water Assessment."

Water Industry Training currently has about 70 active women trainees studying towards a range of qualifications from the National Certificate in Wastewater Treatment to the National Diploma in Drinking Water – Drinking Water Assessment. Fiona Turner, who works for Water and Waste Services for Dunedin City Council and is based at the Tahuna wastewater treatment plant, is one woman who loves her job.

"I've had a range of different jobs. When I first left school I was a hairdresser, then I moved into sharemilking and then 10 years ago I moved into the wastewater treatment sector. This sector interested me because I've always been concerned about the environment and had a passion for looking after it. I'm more interested in the 'dirty' side than the 'clean' side of water treatment!

Fiona completed the National Certificate in Wastewater.

The National Certificate in Wastewater Treatment (Level 4) is for people working under supervision with local Government or industrial wastewater systems who wish to achieve higher professional standards, develop safer working practices and progress their career.

"The course really opened my eyes. It taught me the operational side of my job, and gave me that inside knowledge. We learnt about how the wastewater treatment network functions in terms of industrial waste and the processes that are necessary to treat the waste," Fiona says.

"I've done a variety of roles during my ten years at Tahuna from Trade Waste sampling to environmental sampling at beaches. I'm now the Business Support Officer at the Tahuna plant, so I keep the business side of the operations in line, including the financials. I need to ensure everything is running smoothly from a business support perspective especially since we have been undergoing an upgrade at Tahuna from primary sedimentation to secondary treatment with UV disinfection, so there is a lot going on!

Fiona has one more thing to add about the Water Industry Training course.

"I really enjoyed the networking aspect of the course. You meet people in your industry, who are all doing similar jobs to you. If you come across a problem at work, you think back and remember someone you met on the course who has the same treatment operations as you, so you think "I'll give them a call." It's very sociable and a great way to connect with other people in the industry which I think is incredibly valuable."

Sylvia Hubbard is another person who enjoys her job.

"When my husband passed away, I had to take over our family business. So I contacted Water IT, and they suggested that I do the Diploma in Wastewater Management. In some ways, they rescued me, because I learnt so much. I found the course very useful, and very informative. It helped me to see things in a more organised way."

Sylvia's company, Greenacres Waiheke, has the goal of building a community based sustainable sewerage treatment system based on individual on-site sewerage treatment systems and verifiable records relating to each individual property that will keep the island green.

"I see my job as an ongoing job of keeping my Waiheke world tidy. There are 6,000 septic tanks on Waiheke and a population of 8,000. Every time a sewerage tank is desludged and everything's flowing, it's like part of a jigsaw is being put into place. I enjoy keeping everything orderly and tidy! I feel like that's my job, and it's very satisfying." ■

"I really enjoyed the networking aspect of the course. You meet people in your industry, who are all doing similar jobs to you."

Overcoming Rotorua Lakes Ecological Challenges

Peter Browne – Enviromex NZ Ltd

Abstract

Over many years the increasing incidence of nuisance algal blooms in some of the Rotorua Lakes has been the catalyst for studies to identify reasons for the general decline in water quality. These studies cite the combined nutrient inputs from anthropogenic and natural sources in regard to their specific contribution to the problems of lake water quality. Over the last decade there has been a strong focus on setting targets to control nitrogen and phosphorus loads, the main drivers for changes in lake trophic condition. In recognition of the importance of the Rotorua lakes, Bay of Plenty Regional Council has set statutory environmental bottom lines in the form of specific Trophic Level Indices (TLIs) for all the Rotorua lakes in the Water & Land Plan (W&LP). This has led to investigation and implementation of selected restoration methods to overcome the immense challenges of managing and treating large bodies of lake water. This paper briefly covers the reasons and effects of changes in water quality and introduces methods currently in operation to control excess nutrients. Although the Rotorua Lakes programme targets substantial decreases of both nitrogen and phosphorus loads, this paper is primarily concerned with the control of phosphorus.

Keywords

Lake restoration, freshwater nutrient control, sediment capping, stream treatment, alum addition.

1. Introduction

As early as the 1960s reports of deteriorating water quality of iconic Rotorua lakes identified excess nutrients as a major contributing factor. A definitive report by Fish in 1975 and subsequent reports by others quantified nutrient loads, their source, water shed characteristics and related activities. These studies contributed to an understanding of conditions and circumstances leading to entry of nutrients into the lakes, particularly nitrogen and phosphorus that are viewed as primary drivers causing eutrophication in the lakes measured as changes in trophic state (biological production, especially plant and algal life).

"In April 2007 a Memorandum of Understanding (MoU) was signed between the Lake Strategies Group and Central Government formalising a working relationship to jointly engage through the Rotorua Lakes Protection and Restoration Action Programme."

In 1998 the Te Arawa Maori Trust Board (now Te Arawa Lakes Trust), the Bay of Plenty Regional Council and Rotorua District Council established a Lakes Management Working Group that was tasked with coordinating the efforts of interested parties by setting in place a process that would lead to solving lake water quality problems as efficiently as possible. This culminated in the Lake Management Strategy that set goals for the protection, use, enjoyment and management of lakes and surrounding catchments. The strategy was adopted in October 2002.

In 2006, a Rotorua Lakes Strategic Group was formed, comprising two representatives each from the above parties, as a permanent body under the Local Government Act 2002 and Te Arawa Settlement Act 2006. It's purpose is summarised here as working on actions needed to promote sustainable management of named Rotorua Lakes and watersheds while recognising the intrinsic and cultural values of the people†. In April 2007 a Memorandum of Understanding (MoU) was signed between the Lake Strategies Group and Central Government formalising a working relationship to jointly engage through the Rotorua Lakes Protection and Restoration Action Programme. The MoU set out responsibilities of group members and actions to be examined and implemented.

The Crown, as owner of the lake waters and air space above the lake beds (the lake beds are owned by Te Arawa), provides a national perspective on lake management and funds half a $144m ten year plan, being about half of the overall 20year restoration programme, with the other half funded by Rotorua District Council and Bay of Plenty Regional Council.

In addition, on 9th May 2011 the Government announced its Fresh Start for Fresh Water 2011 reform that includes a National Policy Statement for Freshwater Management that took effect 1st July 2011. This statement directs that regional policies relating to water quality, quantity and integrated management be implemented through Regional Plans by 2014, or if that is not practicable, such other staged implementation by 2030.

Since 2003 and with the same intent as the Government's National Policy Statement for Freshwater, the Regional Council has developed action plans for Lakes Rotorua and Rotoiti, Rotoehu, Rotoma, Okaro and Okareka using methods and objectives under the Regional Water and Land Plan (W&LP). Action Plans for the remaining six lakes are either in progress or under consideration. Most importantly, Actions Plans are regularly reviewed to allow for changes in approach such as developments in technology and best management practices.

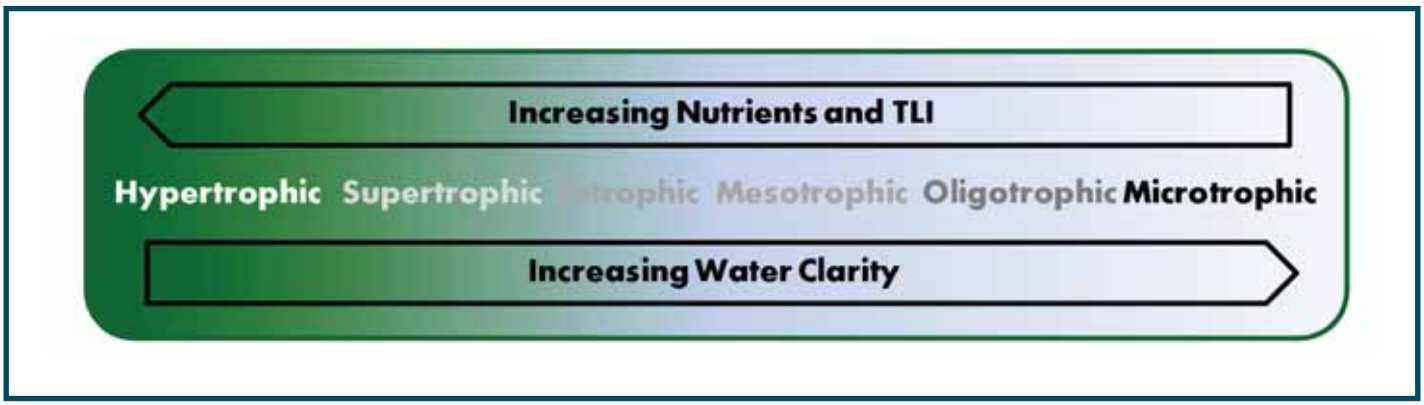
† *For exact wording refer Rotorua Te Arawa Lakes Strategy Group – Terms of Reference*

2. Lake Condition Indicators

2.1 Lake Trophic Level

A frequently used measure of the state of fresh water quality is the Trophic level Index, TLI. It is a calculated value based on measurements taken at selected monitoring sites for each lake. Figure 1 indicates trophic terminology in relation to observed conditions. Microtrophic TLI (0 to 2) is typical of clear glacial melt water where few nutrients are present. TLI's increase by an integer for each trophic state to reach Hypertrophic TLI (6 to 7) that is typical of highly nutrient rich water, e.g. oxidation ponds.

Figure 1 – Trophic states in relation to nutrient load and visual appearance



"Similar conditions exist for Lake Rotoiti where nutrients are generally sufficient (mesotrophic) to support a diverse lake ecology. Lake Tarawera waters are typically low in nutrients (oligotrophic) but support abundant exotic plantlife."

The TLI formula adopted by BoPRC includes Secchi Disk measurements for water clarity, concentrations of chlorophyll a, total nitrogen and total phosphorus. Objective 11 of the W&LP sets TLI targets for each lake as shown in Table 1. These are compared against the most recent three yearly TLI average and annual measurement for 2010/11. Once the three-year average TLI is exceeded by 0.2 units for two consecutive years, Method 41 of the W&LP sets out the process to develop and implement an Action Plan. Most lakes have exceeded this threshold and consequently have operative Action Plans.

Table 1 – Lake TLI targets, 3 year averages and Trophic type

Lake	RWLP TLI target	2011 3-yearly average TLI	2010/11 TLI	Trophic Type: TLI
Rotorua	4.2	4.6	4.3	Eutrophic: TLI 4.0 to 5.0
Rotoiti	3.5	3.9	3.9	Mesotrophic: TLI 3.0 to 4.0
Rotoehu	3.9	4.4	4.1	Eutrophic; TLI 4.0 to 5.0
Okaro	5.0	5.1	5.2	Supertrophic: TLI 5.0 to 6.0
Tarawera	2.6	2.8	2.9	Oligotrophic: TLI 2.0 to 3.0

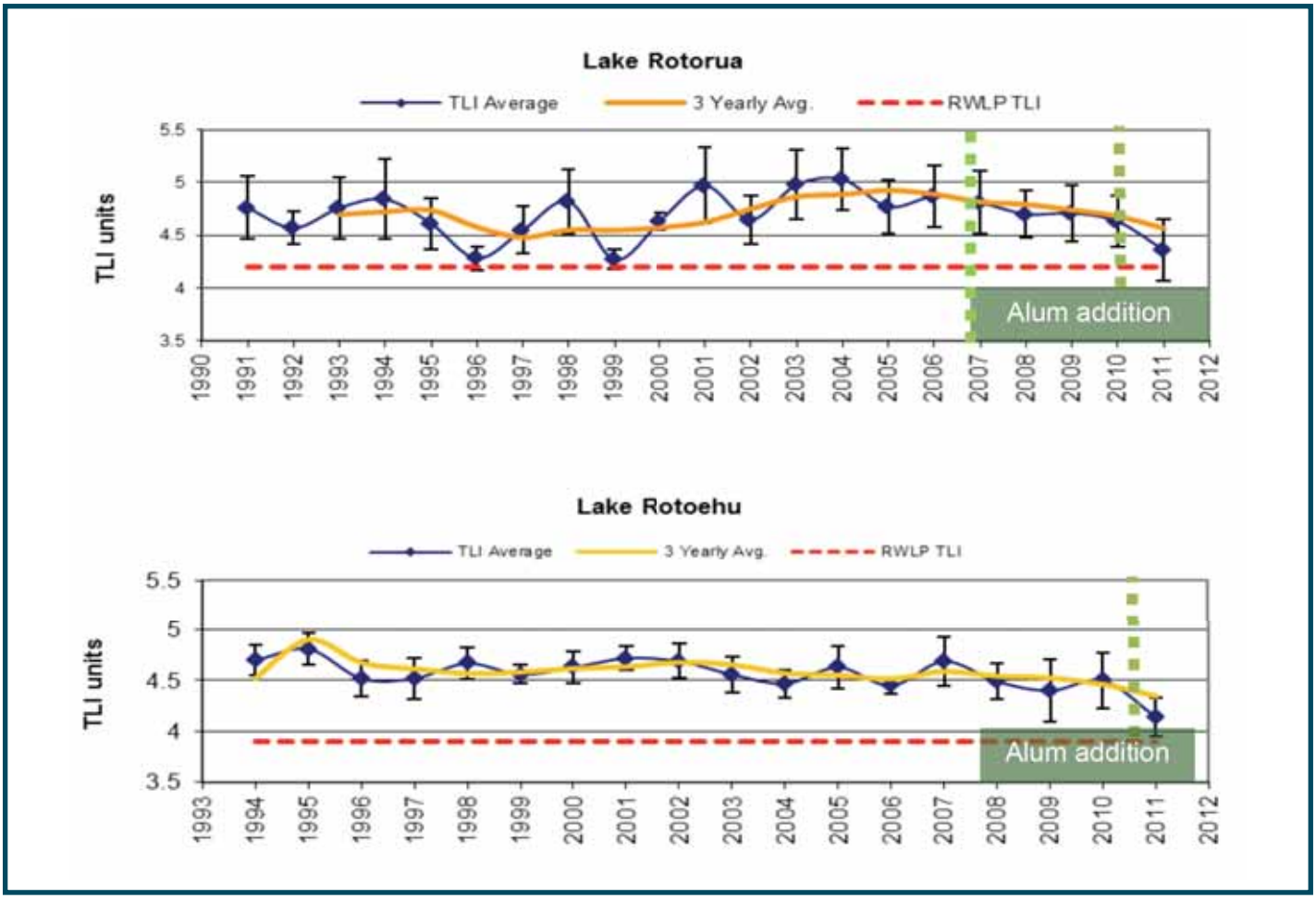
Extract from Table 2.1 of *2011/2010 Rotorua Lakes Trophic Index Update*, BOPRC, December 2011

The Trophic type gives an overall indication of lake condition when examined in conjunction with the Submerged Plant Indicators (SPI). For lakes Rotorua and Rotoehu, the SPI shows plant life to be in poor condition due to proliferation of exotic plants or nuisance plants. Similar conditions exist for Lake Rotoiti where nutrients are generally sufficient (mesotrophic) to support a diverse lake ecology. Lake Tarawera waters are typically low in nutrients (oligotrophic) but support abundant exotic plantlife.

Figure 2 shows annual and 3-year averaged TLI's for lakes that receive alum dosing as part of their restoration action plan. Green flags indicate when alum dosing commenced. Lake Rotorua has two such plants. These lakes show a general improvement in TLI since alum dosing commenced. Of nine other Rotorua lakes with similar TLI records, only Lake Tikitapu (Blue Lake) had a similar TLI drop in 2011.

"Green flags indicate when alum dosing commenced. Lake Rotorua has two such plants. These lakes show a general improvement in TLI since alum dosing commenced."

Figure 2 – Lake Rotorua and Lake Rotoehu TLI's from 1990 to 2011



Source: *2011/2010 Rotorua Lakes Trophic Index Update*, BOPRC, December 2011.

The Trophic level Index is a good general indicator incorporating the measurement of total nutrients, but does not differentiate between nutrient forms and relative availability for uptake by organisms that make use of them. To overcome this, the Regional Council also monitors dissolved nutrients to better understand their influence as a preferential energy source for organisms. Targeting the removal of, or changing the condition of, dissolved nutrient to make them less bio-available prevents their rapid uptake and requires organisms to expend more energy to win the all important nutrients they need to metabolise and propagate. This leads to a key philosophy of alum dosing, that is to control nutrients within the catchments to which it is currently applied, namely to streams flowing into Lake Rotorua and into Lake Rotoehu.

Alter conditions within a lake to limit the preferential uptake rate of nutrients by nuisance organisms and thereby prevent their proliferation.

The most ideal outcome is to 'lock' sufficient bio-available nutrients to control lake trophic levels at aesthetically desirable levels while maintaining a healthy lake environment.

2.2 Nutrient Loads into Lake Rotorua

There are various studies estimating nutrient loads that enter Lake Rotorua with predictions ranging from year 1900 to 2055 as summarised by Rutherford, May 2008. The values for nitrogen and phosphorus for years 1965 to 2005 are given in Table 2. These exclude particulate nutrients that are considered to be not available to phytoplankton.

In addition, Lake Rotorua can stratify one or more times per year, typically in the summer, for a duration approaching two weeks per event where hypoxic conditions (DO<3) prevail within the hypolimnion. This results in the release of phosphorus and nitrogen from lake sediments which build up in the hypolimnion layer. When the lake mixes these nutrients are available for uptake by algae that rapidly proliferate to cause eutrophication of lake waters. After the nutrients are consumed the algal die-off and settle which results in nutrients accumulating in the top layer of sediment again. This cycle is shown as 'internal' load in Table 2 and is additional to other nutrient inputs entering Lake Rotorua.

Target nutrient input loads for Lake Rotorua (excluding internal loads) have been set at 37 T/yr phosphorus and 435 T/yr of nitrogen, which includes a small allowance for nutrients from treated sewage

(3 T P/yr and 30 T N/yr). Currently the lake receives 'Land Use inputs' that are less than 'Land Use exports', the difference being nutrients transported via groundwater which can take multiple decades (predictions for some areas up to 150 years) before groundwater nutrients input to the lake. The ROTAN model predicts about 30 years delay for total nutrient loads to equilibrate, although the mean retention time for water in some Rotorua springs exceeds 100 years. Total inputs include all sources of nutrient entering the lake. Therefore the difference between target loads and future total input loads (as predicted in 2003) will increase for years to come.

The Lake Rotorua and Rotoiti Action Plan set target nutrient reductions to year 2029 of 10 T/yr phosphorus and 250 T/yr nitrogen. The phosphorus reduction target includes an allowance for the lake internal loading, groundwater lag time and growth in the area.

Table 2 – Nutrient loads to Lake Rotorua (T/yr)

Nutrient	1965 to 2005[1]	Internal[2]	Land Inputs[2]	Land Use & Ground water[2]	2003 Total Inputs[2]	Target[2]
Nitrogen	206 to 598	360	562	746	783	435
Phosphorus	34 to 42	36	39	39	40	37

1. Rutherford, 2008
2. Lakes Rotorua and Rotoiti Action Plan, 2009

2.3 Nutrient Sources

After sewage nutrients were irrigated in Whakarewarewa Forest, by far the greatest contribution of nitrogen is from the rural sector, as shown by the nutrient load summary in this section. In the case of phosphorus, natural sources are similar to rural inputs. This fact broadens council's options to control phosphorus. Natural springs are typically phosphorus rich point source flows entering the lake and therefore amenable to adding controls while longer term rural initiatives are developed and implemented.

Approximate source loads in tonnes per year are:–

	Nitrogen	Phosphorus
Rural		
– Bush/Forest	19	0.5
– Sheep / Deer	93	3
– Dairy	466	14
– Exotic forest, cropping, etc	41	1.5
Natural		
– Geothermal, rain, springs and indigenous forest	115	18
Urban		
– Stormwater, wastewater reticulation and septic tanks	50	4

Assessed from *Lakes Rotorua and Rotoiti Action Plan*, July 2009

3. Nutrient Sources and Reduction Initiatives

3.1 Brief Outline of Nutrient Management Initiatives

A broad range of actions are under investigation to control nutrients, with many being 'in progress' or 'in action' at the present time. Only a brief list of actions can be given within the scope of this paper. It must be recognised that lake water quality changes reflect the cumulative nutrient savings from all actions and are not entirely due to phosphorus locking to which this paper principally refers. However it is equally valid to note that many actions are not yet in place, and consequently, progress on water quality within Lake Rotorua is largely attributed to alum addition for the control of phosphorus.

Expected nutrient reduction loads in tonnes from the various initiatives are:–

	Nitrogen	Phosphorus
Rural		
– BPO	30 by 2012	> 0
– Farm Management	56 by 2019	3.5
– Research and evolving management practices	84	6.5
Natural		
– Tikitere geothermal brines treatment of ammonia	< 20	0
– Phosphorus locking in streams	Nil	6
Urban		
– RDC WwTP improvements	15	4
– Settlement septic tank improvements	11	0.3
– Stormwater improvements	3	0.5

Assessed from *Lakes Rotorua and Rotoiti Action Plan*, July 2009

3.2 Stream and Spring Nutrient Inputs

There are nine significant streams and a number of minor streams contributing flow to Lake Rotorua. Table 3 is derived from BOPRC stream monitoring records that have been averaged over a ten year period prior to alum treatment (1992 to 2003). Only five major streams are noted. Highlighted streams are now treated with alum which started with the Utuhina in 2007 and Puarenga in April 2010. The nitrogen values show that most nitrogen is in the oxidised form nitrate/nitrite (where NNN = TN — TKN), and therefore is little affected by alum treatment. The key initiative for treating stream water with alum is to control Dissolved Reactive Phosphorus, DRP, to curtail it's rapid uptake by organisms when mixed with lake water, particularly types of phytoplankton that cause algal blooms and scums.

Table 3 – Stream sources of phosphorus (abridged list)

Stream	Flow (m^3/s)	Nitrogen (T/yr)		Phosphorus (T/yr)		Phosphorus Morgenstern TP – Y2004
		TN	TKN	TP	DRP	
Hamurana	2.53	59.2	5.9	7.3	6.5	6.3
Awahou	1.55	62.3	9.3	4.5	4.1	3.3
Puarenga	1.75	65.5	27.2	6.3	3.6	3.6
Waingaehe	0.22	12.3	5.2	1.7	0.9	0.7
Utuhina	1.96	67.1	24.1	5.4	4.0	2.5

> "A broad range of actions are under investigation to control nutrients, with many being 'in progress' or 'in action' at the present time."

3.3 Benchtop Work to Reduce Phosphorus in Stream Water

There have been a number of benchtop tests conducted on waters from various streams in the Lake Rotorua watershed that demonstrate the effectiveness of alum as an efficient phosphorus locking agent. These studies compare commonly used and readily available coagulants of alum and ferric chloride against proprietary products designed for capping of lake sediments such as Phoslock™. The studies clearly demonstrated rapid uptake of dissolved reactive phosphorus, DRP, onto trivalent aluminum oxyhydride and slower performance of proprietary products at equivalent dose rates. However it is important to note that proprietary products are not designed for in-stream treatment of phosphorus and these studies must not be considered to detract from their application as lake sediment capping materials.

During 2004/5 Utuhina and Puarenga Streams were evaluated for the uptake of DRP onto coagulants, alkalinity deficit and the impact of low pH conditions on oxyhydride floc. Later benchtop studies had similar outcomes for water from Waitangi Soda Springs (phosphorus and iron rich thermal water that feeds Lake Rotoehu) and on Lake Rotorua water collected from BoPRC monitoring points. All benchtop chemical trials were sampled at site and pre-treated with analytes measured by a registered analytical laboratory. Analyses included TP, DRP, Alkalinity, pH, Al, Fe and others as necessary to investigate performance of reagents to remove or lock phosphorus.

In later tests a computer controlled Boltac gang-stirring paddle mixers with 1-litre samples were dosed with 1% coagulant to achieve the desired active chemical concentrations. They provided an excellent basis for completing the benchtop work. The mixing energy could be varied to approximately mimic conditions that could be expected to occur over the mixing zone of the stream.

Figure 3 – Benchtop equipment used to simulate performance of alum to lock/remove phosphorus

Selected results from various benchtop work are given in Figure 4 and Figure 5. Utuhina Stream results show that alum is slightly more effective than ferric chloride for control of DRP when the dose exceeds 0.5ppm. There is little merit in dosing the Utuhina Stream with much more than 1.0 to 1.5 ppm Al^{3+}. At these rates greater than 70 percent binding of DRP onto aluminum can be expected.

Puarenga stream results show that higher alum dose rates are required to bind DRP. The optimal dose rate is between 1.5 to 2.0 ppm Al^{3+}, or up to 20 ppm alum at 47% stock solution.

Precious.

Excelling in the provision of electronic data capture systems, meter reading technologies and accurate metering solutions. Ensuring the sustainability of our most important resource.

Because Every Drop is Precious.

www.adriley.co.nz

Arthur D. Riley & Co. Ltd.

fieldsmart technology

Auckland: (09) 444 2350
Wellington: (04) 472 7614
Christchurch: (03) 379 2628

Figure 4 – Utuhina: Phosphorus removal efficiency

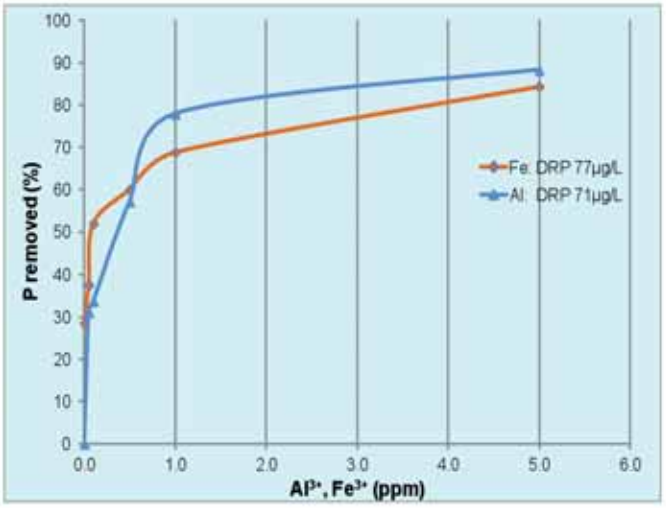
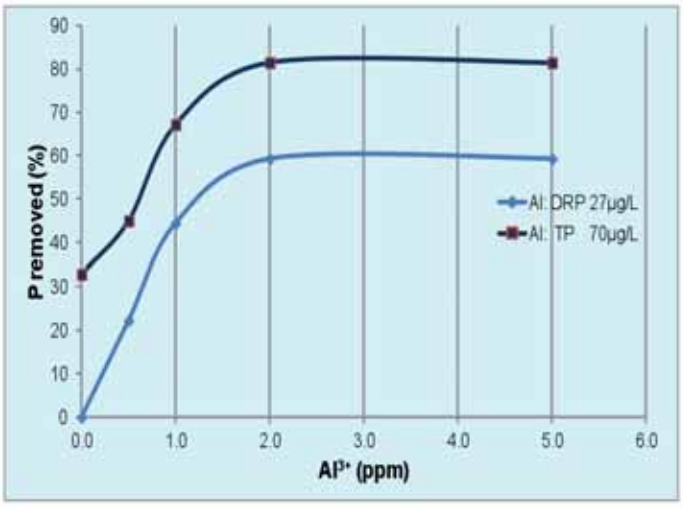


Figure 5 – Puarenga: Phosphorus removal efficiency



The concept of phosphorus locking was developed from observation of results such as Figures 4 and 5 where rapid uptake of phosphorus occurred at only a low dose of aluminum. It was also speculated that low concentrations of aluminum having a long contact time with lake water may have the added benefit of complexing more phosphorus than was demonstrated by short duration contact with stream water.

3.4 Cost to Remove or Lock Phosphorus from Stream Water

An early initiative of the chemical reagent program looked to totally remove phosphorus from stream water to achieve a reduction of phosphorus into Lake Rotorua. This required a dose rate somewhere between 3.0 to 5.0ppm Al^{3+} to create a floc of sufficient size to be readily removed by filtration and/or sedimentation.

The treatment facilities required to achieve phosphorus removal would involve the following main processes:–

i. Chemical reception, storage and dosing including coagulant, flocculent and alkalinity correction chemicals.
ii. Stream intake/return structures.
iii. Chemical mixing and flocculation.
iv. Sedimentation (and possibly filtration)
v. Compliance pond

vi. Solids thickening and dewatering
vii. Solids load-out facilities
viii. Control centre.

While plant capital costs could be distributed over the life time of the facility, chemical cost is an annual amount that is subject to market fluctuations. An estimate of this cost for a stream of around 2 cumecs flow in 2004 indicated $7,000,000+ capital and $2,500,000 chemical cost annually. As these costs are 'per stream' they are replicated for each stream treated, i.e. three streams would have a total combined chemical cost of around $7.5m annually. This illustrated that chemical costs over a 10-year minimum expected operating life would far out way any other cost. Other matters such as sophistication of the plant and disposal of sludge further discouraged adopting the complete removal of phosphorus. This can be compared to the far more cost efficient and less invasive strategy of a phosphorus locking plant, which cost in the order of $200,000 to $350,000.

3.5 Lake Sediment Capping and Water Circulation

Lake Rotorua stratifies for short periods with hypoxic conditions below 12 metres depth. During this time depleted oxygen below the thermocline deters water life from staying in a barren landscape that is typical of the lake depths. This promotes the concept of capping lake sediments below the 15m contour that contribute most strongly to the internal recycling of nutrients. In this way only the most barren areas of the lake would be affected by the cap, with more ecologically rich margins left untouched. Invaluable work by Gibbs et al (2008) studied the concept of permanently encapsulating nutrients beneath a thin cap of phosphorus adsorbing material to eliminate recycling of phosphorus between the sediments and water column. Of the four substances studied, alum performed well at an application rate of 80g/m^2 to control phosphorus that leaches from the top 4cm of sediment at a rate close to 3.2g P/m^2 at pH 6.8. The alum application rate includes a margin of close to twice the amount implied by the binding capacity of alum that is around 45g P/kg alum at pH 7, an excellent binding ratio of close to 1:1 Al^{3+}:P. However, despite this being the most effective material studied for controlling phosphorus, it was not preferred because the light floc layer formed by aluminum oxyhydride was thought to be susceptible to the actions of currents that might relocate or re-suspend significant areas of the cap. Furthermore alum does little to control nitrogen, a key parameter of concern to the eutrophication of Rotorua lakes.

Apart from the significant cost and supply logistics, other key deterrents to applying a sediment cap are public perception of such a large scale application operation and the fact that deposition of sediments will gradually bury the cap over a period of around ten years to the point where the nutrient internal cycle would completely re-establish itself. This would require the lake sediments to be capped at intervals of less than ten years to maintain control of the internal nutrient cycle.

A later study by Gibbs et al (2011) examined lake currents to understand the movement of lake water in relation to wind direction and other contributing environmental factors. These studies found during non-stratified conditions that the entire lake water body uniformly circulates around the island of lake Rotorua at between 100 to 700m/h depending on wind speed. The higher velocity (0.2m/s) is noted as being sufficient to suspend fine sediment. A reverse in wind direction forced the direction of water rotation to also reverse within a day or two. During stratified conditions surface waters continued to respond to the wind as for fully mixed conditions, however water below the thermocline the water rotated in the opposite direction and at a similar velocity to that above. These studies confirmed that

"Lake Rotorua stratifies for short periods with hypoxic conditions below 12 metres depth. During this time depleted oxygen below the thermocline deters water life from staying in a barren landscape that is typical of the lake depths. This promotes the concept of capping lake sediments below the 15m contour that contribute most strongly to the internal recycling of nutrients. In this way only the most barren areas of the lake would be affected by the cap, with more ecologically rich margins left untouched."

targeting selected areas of the lake sediments would need to be done while there is little current and the capping material will need to withstand the action of low velocity currents.

Though many of these studies were not done when stream application trials of alum began they demonstrate that any method of applying a substance that could continually control at least one of the key nutrients and have minimal effect on the habitat and water quality would overcome many obstacles of a comprehensive capping plan, particularly if it avoided the need to add other chemicals designed, for example, to sustain lake water alkalinity (i.e. consumed in the formation of an oxyhydride complex when applied in bulk).

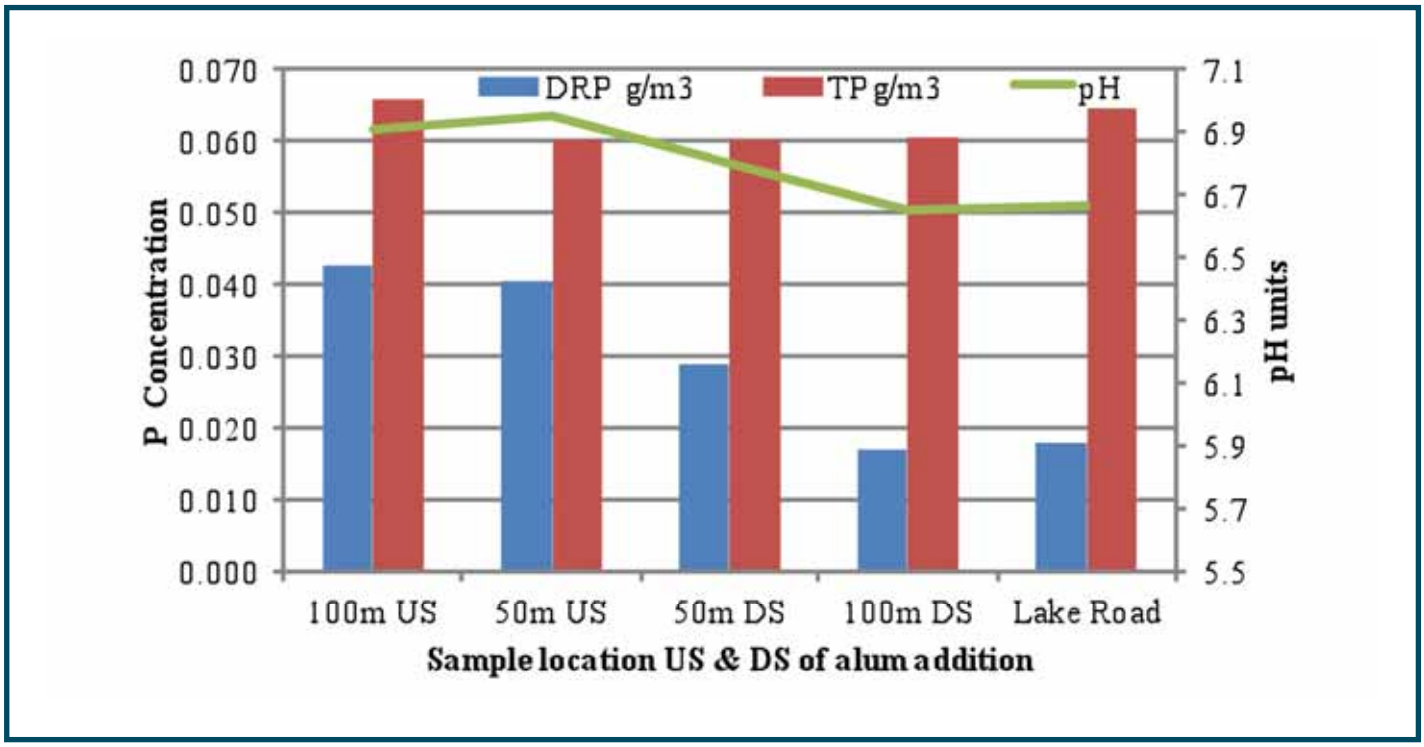
3.6 Stream Trials of Alum Application

Stream trials involved the construction of an alum storage and dosing facility at Depot Road, Rotorua. The facilities include a 30,000L chemical grade tank with secondary containment bund and a chemical metering system to an outfall diffuser in the Utuhina Stream. The outfall position was selected for it's proximity to downstream bridge buttresses and stream directional changes that promote mixing of alum added to the stream water. Monitoring by BoPRC during August 2006 to March 2007 from above and below the outfall point is shown in Figure 6 as averaged results. Total nitrogen remains reasonably consistent throughout the study area despite various drain and minor stream inputs. Dissolved Reactive Phosphorus, DRP, results are consistent for the upstream monitoring points and show that alum mixing and reaction is well in progress by 50 metres downstream and complete by 100 metres downstream. Monitored results suggest that 1mg/L Al^{3+} will give DRP of between 0.002 to 0.02mg/L when treating Utuhina Stream water. The treated water result for the target dose rate of 1mg/L Al^{3+} is therefore slightly better than indicated in Figure 6 giving a 75 percent reduction in DRP at a concentration ratio of aluminum to DRP is 33:1, which is less than achieved during the benchtop work of 18:1. This is due to the stream DRP start value of 0.042 and benchtop DRP start value of 0.071mg/L, and stream water having a pH value outside of the maximum efficiency range of alum.

These ratios fall well short of the binding ratio of 2:1 achieved for sediment trials, which suggests additional binding capacity exists for

stream dosed alum that can be exerted once mixed with lake water, particularly where aluminum oxyhydride meets more favourable pH conditions when in contact with sediments. Alum added to stream water drops the pH by 2 points causing little if any effect. Normal stream water pH is close to pH 7, well above the optimal range for alum of 5.5 to 6. Despite this, the trials proved effective in control of DRP. The dosing facility trial finished in 2008 and now functions as a key lake restoration project. Success of the Utuhina facility lead to implementing a second facility situated within Rotorua Wastewater Treatment Plant grounds that adds alum to the Puarenga Stream.

Figure 6 – Utuhina Stream phosphorus and pH profile



The Puarenga facility in Figure 7 is conceptually similar to the one at Utuhina. It was commissioned in 2010 to deliver 2ppm Al^{3+}, as indicated by benchtop work results shown in Figure 5 above. The Puarenga facility is an existing disused wastewater plant alum dosing system that was refurbished for the purpose of a phosphorus locking plant.

The Waitangi Soda Spring phosphorus locking facility is situated in the immediately vicinity of a commercial bathing complex. The building is essentially a covered bund where all operational activities are completed without any need to enter the building.

Figure 7 – Puarenga Stream phosphorus locking facility

Figure 8 – Lake Rotorua and Lake Rotoehu TLI's from 1990 to 2011

"Interestingly, Rainbow and Brown Trout (*Oncorhynchus mykiss and Salmo trutta*) and Koura (*Paranephrops planifrons*) populations generally increased during the study period suggesting alum had no clear effect on stream biota despite two years of alum dosing."

3.7 Bio-Monitoring of Utuhina Stream

In August 2008 Scion produced results of two surveys studying the condition of various Rotorua streams in regard to fish abundance over the period November 2006 to July 2008. For the Utuhina Stream notable changes in fish abundance were recorded during the first year of alum dosing. The common bully (*Gobiomorphus cotidianus*) greatest decrease in density coincided with the highest dose rate of alum over months of the plants early operation. The latest survey however shows these populations have re-established which suggests they have either acclimatised or the decline in population was associated with other factors.

Interestingly, Rainbow and Brown Trout (*Oncorhynchus mykiss and Salmo trutta*) and Koura (*Paranephrops planifrons*) populations generally increased during the study period suggesting alum had no clear effect on stream biota despite two years of alum dosing. Aluminum increased in tissue samples of biota in the Utuhina Stream compared with that of other Rotorua streams with the most significant being in the animals liver. There was minimal increase in flesh.

It is also noted that toxicological studies focus on a pH<5.5, where aluminum is more likely to adversely affect fish by adhering to gill surfaces. Stream and lake water pH is close to pH 7 where aluminum does not exhibit strong toxicity. Fish are also able to move away from water conditions that they sense as unfavourable, e.g. stream mixing zones, too warm, too bright, etc.

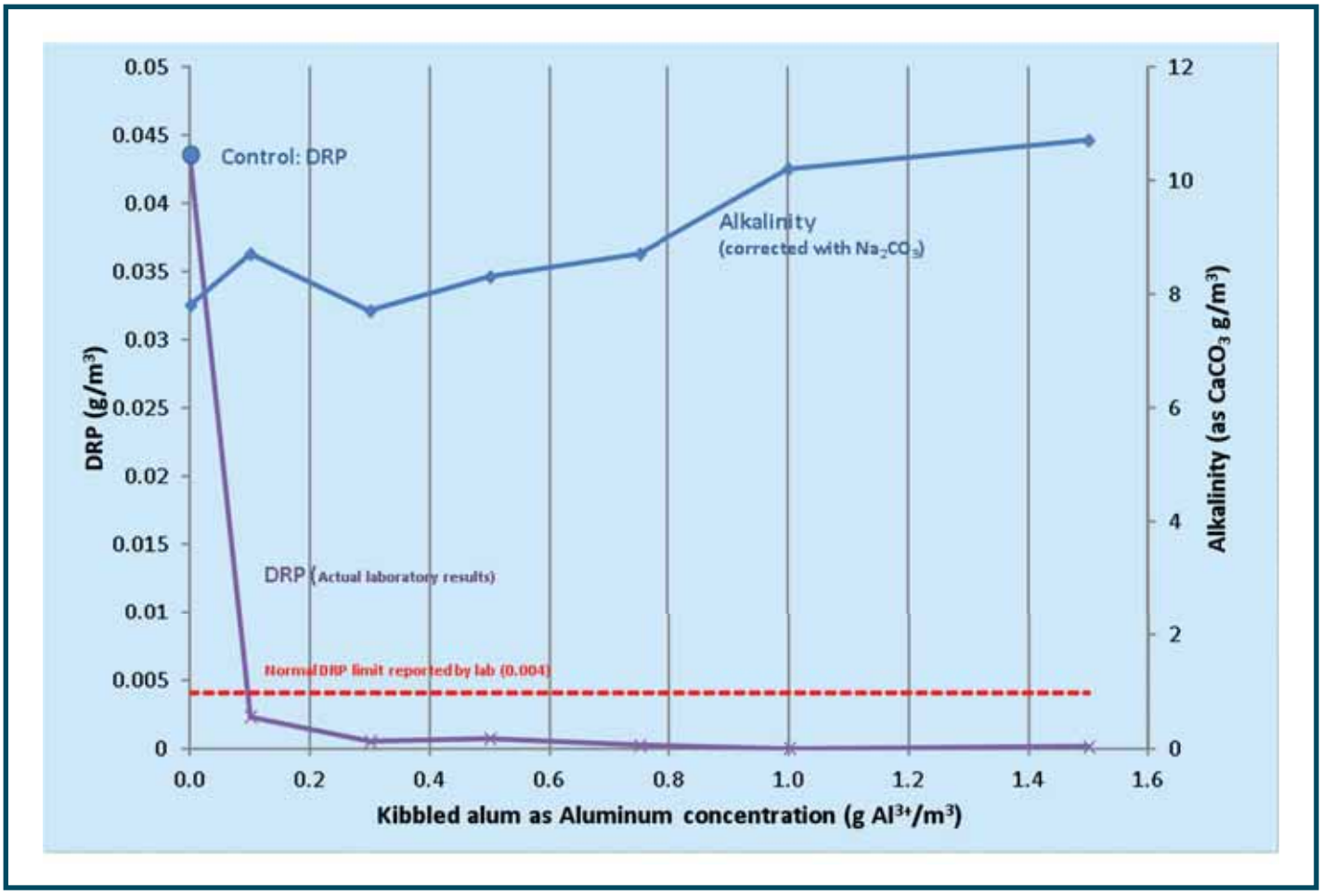
Overall, the study concludes there is no loss of fish population density attributable to aluminum dosing into Utuhina Stream water.

4. Effects on Lake Rotorua

4.1 Lake Rotorua Benchtop Work

Benchtop work on Lake Rotorua water confirmed that low concentrations of aluminum addition will form a settleable floc. A 24-hour settling column test showed that aluminum at 0.3mg/L was sufficient to form a thin layer of settled material and 0.1mg/L locked the available DRP. Figure 9 shows rapid locking of DRP to beyond the detectable limit of the laboratory test. The alkalinity of each sample was maintained relative to the control sample by adding sodium carbonate during the rapid mix stage to hold the pH at 6.5. Even at one percent solution sodium carbonate continued to adjust pH for some time after it was added making it difficult to match that of the control. This caused the final pH of more heavily dosed samples to be half a pH unit higher than required, and consequently alkalinity of 3mg/L higher than the control. It is also noteworthy that adding 0.3mg/L aluminium only reduces the lake water pH by 0.1 units which implies an alkali buffer is not required when adding alum at these low rates.

Figure 9 – Locking of DRP in Lake Rotorua water treated with 1% solution kibbled alum



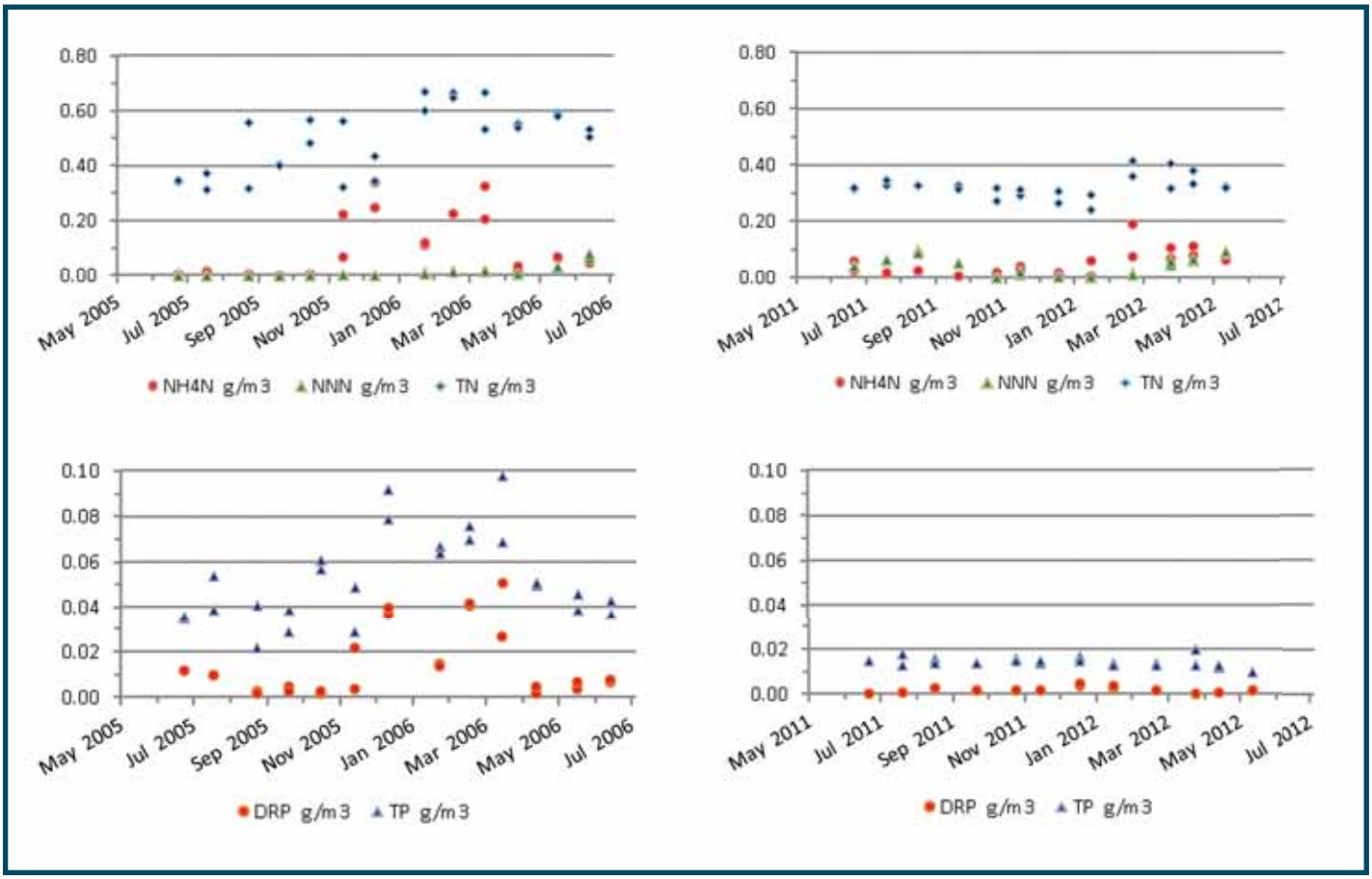
This suggests that aluminum oxyhydride resulting from alum addition to Lake Rotorua streams will precipitate to settle with algae and be deposited at the lake bed, gradually and continuously integrating with sediments. If enough aluminum is deposited, phosphorus released from the sediment during degradation of settled algae will instead be substantially locked onto aluminum, thereby minimising it's bioavailability. There are some early monitoring results in support of the hypothesis that this mechanism may be taking effect. Recent results from the Regional Council for nitrogen and phosphorus indicated a normal seasonal hypoxic release of nitrogen and subdued release of phosphorus from lake sediments. Also noteworthy is that proliferation of blue-green algae was suppressed which is tentatively attributed to a deficiency of excess phosphorus in the water column. Ongoing work is planned to determine the amount of aluminum accumulating in lake bed sediment and to confirm the extent of changes in the algal population. The mass of accumulated aluminum can then be compared against the amount needed to effect capture of phosphorus.

Aluminum in the colloidal form is unlikely to settle and will continue to circulate within the water column for long-term contact with phosphorus until it either grows sufficiently to precipitate and settle, or is ultimately flushed from the lake.

4.2 Lake Rotorua Water Monitoring Results

Figure 10 shows lake water nutrient analyses from samples taken as part of Regional Councils lake monitoring program. Plots to the left are nutrient concentrations in Lake Rotorua water during the period May 2005 to July 2006, prior to the addition of alum. Plots to the right are nutrient concentrations over the period during 2011/12. There is a clear trend of lower phosphorus concentrations for both total and dissolved reactive forms with a 7-fold reduction in DRP and nearly 4-fold reduction in TP which represents a massive reduction of phosphorus available to algae. While aluminum will not directly lock nitrogen, it is plausible that secondary effects are causing a change here as well. Some decline in nitrogen values will be due to initiatives to control land and urban inputs to the lake. However the bulk is likely due to disruption of the lake internal nutrient cycle and some flushing of soluble nitrogen by discharge through the lake outlet. Work is ongoing to determine the mechanisms occurring.

Figure 10 – Comparison of Lake Rotorua Nutrient concentrations



"Aluminum in the colloidal form is unlikely to settle and will continue to circulate within the water column for long-term contact with phosphorus until it either grows sufficiently to precipitate and settle, or is ultimately flushed from the lake."

5. Conclusions

The present objective of dosing alum to streams goes beyond the initial concept of locking phosphorus in the stream flow. Natural circulation of lake currents are utilised to distribute the aluminum, and long contact times are used, to continue locking phosphorus within the lake body itself. The greatest benefit however is not limited to locking of phosphorus within the streams, but also the locking of at least part of the 36 tonnes of phosphorus recycled internally from lake sediments. The uniform integration of aluminum into lake sediment promotes maximum opportunity for control of benthic phosphorus, a distinct advantage over the alternative of capping

"The control of blue-green algae could also be of interest at water treatment plants especially where pre-oxidation of water is needed and may otherwise cause release of toxic substances associated with these organisms."

the sediments. Should the locking capacity of lake water phosphorus by aluminium prove as effective as tests indicate, then alum dosing to the contributing streams alone will be a most economic means of improving the lake TLI to target levels and also an excellent means to control it at the desired level while other catchment wide initiatives take effect.

6. Opportunities

There is an obvious opportunity for absorptive materials to be used to control excess phosphorus at other freshwater bodies, though extensive study is needed to balance the likely effects and benefits and a comprehensive program is required to monitor changes in the water body, sediments and life forms.

For a number of years alum has been applied to treated wastewater, with significant capital invested to remove, concentrate and dispose of precipitated phosphorus. An interesting aspect of the phosphorus locking strategy is that only small additions of aluminum are needed to effect control of phosphorus and complete removal of this phosphorus is therefore not required. There is an opportunity to investigate the suitability and acceptability of phosphorus locking of treated effluent without removing it from the discharge. A well planned environmental monitoring program would be needed as part of an overall management plan to confirm environmental aims are met. Phosphorus locking could also be an interim measure while plans and finances are confirmed for the typically heavy expenditure on additional sedimentation and sludge handling facilities. Phosphorus locking facilities cost only a small part of a total phosphorus removal plant.

The control of blue-green algae could also be of interest at water treatment plants especially where pre-oxidation of water is needed and may otherwise cause release of toxic substances associated with these organisms. Low doses of alum to reservoir storages may assist to control algae and assist with locking of phosphorus in sediments. The effect that sustained aluminum accumulations might have on raw water storage turnover conditions cannot be commented on, but is likely to be favourable to treated water quality and therefore worthy of further study.

Acknowledgements

The assistance of John McIntosh of Lochmoigh Ltd to review the various drafts and contribute to the technical content of this paper is gratefully acknowledged.

If you would like further information about this paper please contact Peter Browne on +64 9 950 4463. ■

References

Akhurst D.J., Jones B., Clark M. and McConchie D. (2006) Phosphate Removal from Aqueous Solutions using Neutralised Bauxite Refinery Residues (Bauxisol™), Environ. Chem 2006, 3, 65–74. doi:10.1071/EN05038.

Browne P. (2004) Second Stage: Phosphorus Removal for Rotorua Lakes/Streams, URS Report November 2004.

Browne P. (2009) Waitangi Soda Spring Phosphorus Locking Benchtop Evaluation, Technical Memorandum April 2009.

BoPRC, (2009) Lakes Rotorua and Rotoiti Action Plan, Environmental Publication 2009/03 ISSN 1175 9372.

BoPRC, Rotorua Te Arawa Lakes Strategy Group – Terms of Reference. http://www.boprc.govt.nz/media/73612/rotorua%20te%20arawa%20lakes%20strategy%20group.pdf.

Fish G. R. (1975) Lake Rotorua and Rotoiti North Island, New Zealand, their Trophic Status and Studies for a Nutirent Budget, Fisheries Research Bulletin No. 8, NZMAF, 1975.

Gibbs M., Bremmer D., van Kooten M. and Özkundakci D.(2008) Comparison of efficacy of four P-inactivation agents on Lake Rotorua sediments, NIWA Client Report: HAM2008–105. Bay of Plenty Regional Council.

Gibbs M., Budd R., Hart C., Stephens S., Wright-Stow A. and Edhouse S. (2011) Current Measurements in Lakes Rotorua and Rotoiti 2012 and 2011. NIWA Client Report HAM 2011–015.

Hickey W.H. and Gibbs M. M. (2009) lake sediment phosphorus release management – Decision support and risk assessment framework, New Zealand Journal of marine Freshwater research, 2009, Vol 43:819–856.

Ling N. and Brijs J. (2009) Utuhina Stream Monitoring 2009: Fish and Aquatic Invertebrates, CBER Contract Report 106.

McIntosh J. (2012) Alum Dosing of two stream discharges to lake Rotorua – Internal Report, Bay of Plenty Regional Council.

McIntosh J. (2011) Monitoring of the Puarenga Stream Alum Dosing Plant – Internal Report, Lochmoigh Ltd, Bay of Plenty Regional Council.

Rutherford J.C., Pridmore R.D. and White E. (1989) Management of Phosphorus and Nitrogen Inputs to Lake Rotorua, New Zealand, http://monitoring.boprc.govt.nz/TechReports/TechReports-000000-ManagementPandN.pdf

Scion Research. (2008) Fish community surveys and biomonitoring in selected Rotorua Streams. http://www.boprc.govt.nz/media/97574/finalscionrotoruastreamsreport15808.pdf

Scholes, P. (2011) 2010/2011 Rotorua Lakes Trophic Level Index Update, Bay of Plenty Regional Council Environment Publication 2011/17 December 2011 ISSN: 1179–9471

1) President Clive Rundle speaks at Conference Dinner and Awards Presentation, 2) Members of the all volunteer Conference Technical Committee are acknowledged at the dinner by President Clive Rundle for their contribution, 3) Conference Dinner and Awards Presentation table centre pieces, 4) President Clive Rundle speaks during the passing of the gavel, 5) Water New Zealand team and Jonathan Mackey NZWETA at the Water New Zealand stand, 6) Chief Executive Murray Gibb speaks at the Conference Dinner & Awards Presentation, 7) Bruce Porteous, Mathew Jamieson (Orica Chemnet Operations prize winner) and Clive Rundle, 8) President Elect, Steve Couper receives the President's gavel from Clive Rundle, 9) Members of Te Arawa iwi at the powhiri, 10) Rob Blakemore, Mathew Jamieson (Opus Trainee of the Year prize winner) and Clive Rundle, 11) Fiona Crombie (Ronald Hicks Memorial Award winner), Ian Gunn, Mark Pizey (Ronald Hicks Memorial

Award winner) and Clive Rundle, 12) Brad Blaze and Mike Stapleton from Water Supply Products on stage, 13) Brad Blaze entertains delegates during the Conference Dinner and Awards Presentation, 14) Brad Blaze reveals his speed painting portrait of Bono, 15) Clive Rundle presents Ian Gunn with the Water New Zealand Association Medal for outstanding contribution to New Zealand, 16) Adrian Hynds, Pete Browne (Hynds Paper of the Year winner) and Clive Rundle, 17) Thomas Haarhoff presents Sally Dymond with the AWT Best Poster Award, 18) Guests enjoy the chance to catch up at the Conference Dinner & Awards Presentation, 19) Delegates in the Foyer and Registration area at the Energy Events Centre, Rotorua, 20) Murray Gibb, Annie Feng (CH2M Beca Young Water Professional of the Year Award winner) and Clive Rundle, 21) HydroTech Drainage – winner of Best Expo Stand, 22) The Welcome Reception sponsored by ABB

Water Planning for Quantity and Quality

Helen Atkins, Partner and Vicki Morrison, Senior Associate – Atkins Holm Majurey

Introduction

In previous articles we have covered a number of legislative reforms that are underway in the local government, resource management and water areas. At the time of writing this article we were still waiting for the Land and Water Forum Third Report and to see the outcome of work of the Local Government Efficiency Taskforce. We provide information on another appointed taskforce that is looking at local government infrastructure but leave detailed comment on other reform issues for a later edition. In this article we focus on the approaches to water management that are being considered by regional councils throughout the country.

Local Government Infrastructure Taskforce

On 28 September 2012 Local Government Minister David Carter announced an independent expert advisory group to help local government provide more cost effective infrastructure. The eight-member group is one of the initiatives outlined in the *Better Local Government* reform programme announced earlier this year.

The advisory group will be chaired by Greater Wellington Regional Council Chair, Fran Wilde. Other members are:

- Stephen Selwood, Chief Executive of New Zealand Council for Infrastructure Development
- Jeremy Sole, Chief Executive of New Zealand Contractors Federation
- Josephine Grierson, businesswoman and infrastructure economics expert
- Liz Anderson, Infrastructure and Policy Consultant
- Debbie Packer, former Deputy Mayor of South Taranaki
- Philip Cory-Wright, director, infrastructure company advisor and investment banker
- Alan Bickers, former local government chief executive and engineer

The expert advisory group is due to report back in February 2013. That report will feed into a second piece of local government reform legislation planned for next year.

Water Management by Regional Councils

Waikato Region – Variation 5

A discussion on water management would not be complete without mentioning Regional Plan Variation 5 – Lake Taupo Catchment. Variation 5 sets out the nitrogen management regime for the Lake Taupo catchment[1]. The Variation caps the amount of nitrogen entering Lake Taupo from urban and rural activities.

In brief, the variation contains policies that reduce and require the formation of the Lake Taupo Protection Trust to assist in achieving the 20 per cent reduction in the amount of nitrogen entering Lake Taupo. The Variation contains rules that have implications for land that is utilised for existing or proposed:

- farming operations
- forestry operations
- undeveloped land
- any changes to land use including residential development/ subdivision and conversion to/from forestry/farming.

Variation 5 is still in its implementation phase a phase that will last many years. It will be some time before the impact of Variation 5 is felt in terms of discernible improvement in lake water quality.

Waikato Region – Variation 6

In our February article we provided a detailed review of the Environment Court decision in Variation 6 to the Waikato Regional Plan.

Variation 6 was developed as a means of managing freshwater allocation within the Waikato region given the increasing and competing demands for freshwater particularly between electricity generation and agricultural uses (primarily dairy farming). The Variation progressively introduces new policies and rules for allocating and using water in the region.

The Environment Court decision, in part, reflected the agreement that came about during negotiations over the wording of the policies and rules as part of court proceedings brought against the original version of Variation 6. Now that there are no further appeals the Council can proceed to implement the framework over the coming months and years.

As noted in a Council media release shortly after the Court's decision:

> *The scale of the issues involved is huge. Consumptive demand for surface water in the Waikato is 1.36 million cubic metres of water a day, while consumptive demand for ground water is 430,000 cubic metres a day. It's been estimated every drop flowing out to sea from the Waikato River has been removed from the natural river channel and used in some way at least seven times before it reaches the ocean.*
>
> *Implementing Variation 6 is hugely important because pressure on water resources has increased significantly in recent years. For example, the area of land being irrigated has nearly doubled in the last ten years. Water is a finite resource and, in some places, is already fully allocated. Variation 6 seeks to strike a balance between managing the adverse environmental effects of taking and using water and giving people the ability to use water in an environmentally sustainable way.*[2]

Otago Region – Plan Change 6A

Proposed Plan Change 6A is part of a suite of plan changes proposed by Otago Regional Council to provide a water management regime for the region.

The Plan Change aims to give effect to the Council's 2010 Rural Water Quality Strategy. That Strategy – Good Water, Good Farming which itself aims to ensure that Otago's waterways remain healthy. The strategy proposes an effects-based approach to managing rural discharges to water, with a focus on directly controlling contaminants discharging from land to water, instead of controlling land use activities. Maximum discharge limits are set for common rural contaminants, and discharges from land achieving those limits are permitted. The strategy states that this provides the land manager with flexibility to implement whatever changes are needed to meet the discharge limits that best suit their land management regime.

Since the time the strategy was released the National Policy Statement on Freshwater Management became operative. The Council therefore undertook a review of its strategy in light of the NPS and decided it needed to amend its plan.

The proposed revisions to the Otago Water Plan in Plan Change 6A to implement the strategy and give effect to the NPS include rules which set limits for controlling the amount of contaminant that can be discharged from farm drains, and through runoff and leaching.

Plan Change 6A is in the middle of hearings before hearings commissioners.

The Officer Report[3] states that there are many submitters supporting the effects based focus of the Plan Change but there are a number of submitters seeking withdrawal of the plan change for a number of reasons:

- Whether the proposed plan change is consistent with the RMA, NPSFW and Regional Policy Statement for Otago and not contrary to sound resource management
- Whether the limits proposed are lawful, workable and achievable
- Whether land use controls should be used instead
- Whether there is a need to improve water quality in all parts of Otago, or address water quality catchment by catchment
- Whether dams for hydroelectricity generation are industrial and trade premises, and accordingly, how this plan change may affect such activities
- A need to undertake a more collaboratively based process for addressing water quality
- A need to undertake a more substantive Section 32 analysis of alternatives, and their benefits and costs

This snap shot of the some of the key over-arching issues illustrates the contentious nature of water quality plan changes and the strong views that they invoke.

Water Management in Canterbury

As noted in previous articles the approach to water management (both for discharging into water and allocation of water) is under the overarching framework provided by the Canterbury Water Management Strategy. The Strategy is now in its implementation stage after having been developed in a collaborative process over several years by the Mayoral Forum, a Steering Group, Environment Canterbury and the ten territorial authorities in the region. There are ten zone committees that meet on a regular basis to continue to implement the Strategy throughout the region.

Since the changes to Environment Canterbury none of the plans and policies developed under the RMA have been subject to appeals to the Environment Court.

"It's been estimated every drop flowing out to sea from the Waikato River has been removed from the natural river channel and used in some way at least seven times before it reaches the ocean."

The new regional policy statement for Canterbury has been completed through to the final decision stage. As this document has been appealed to the High Court it is not yet operative. In terms of freshwater management the RPS essentially provides the statutory framework to encompass the implementation of the Water Management Strategy being undertaken by the various zone committees.

The Council has notified its proposed Land and Water Regional Plan which addresses six key issues:

- Competing demands for water in Canterbury
- The need for integrated and consistent management of water and land uses
- Issues arising from interconnected water and land resources
- Soil conservation, gravel resources and biodiversity
- Natural hazards
- Managing new and existing activities

In the information statement on the Plan Commissioner Peter Skelton describes the Plan thus:

The proposed Land & Water Regional Plan, now open for public submissions, is aimed at the most challenging areas for

Canterbury's long-term economic and environmental success, particularly as regards water quality.

When it is in place in early 2014, the Land & Water Regional Plan will establish the mechanisms to enable all the key outcomes of the Canterbury Water Management Strategy – environmental restoration via biodiversity programmes, more reliable water through infrastructure, and improved land and water management within collaboratively agreed limits.

The Strategy is the first time that the quality of water from various sources has been comprehensively addressed in Canterbury in both urban and rural areas.

Building on the currently operative Natural Resources Regional Plan, the Land & Water Regional Plan is a new planning framework for Canterbury. When it becomes operative in early 2014, it will provide clear direction on how land and water are to be managed.[4]

Submissions close on 5 October 2012 and hearings will be completed by the midway through 2013.

Horizons One Plan – Surface Water Quality – Non-point Source Discharges

The final plan in this discussion is the Horizons One Plan which is the subject of a very recent interim decision of the Environment Court. There were five parts of the One Plan subject to appeal and this discussion is limited to that part concerned with surface water quality – non-point source discharges.

The One Plan has been on a very long journey with notification in 2007, substantive hearings in 2008 and 2009, appeals in 2010 and then a long process of court-assisted mediations to try and settle as many of the outstanding issues as possible.

Of the appeal issues left to be considered by the Court the most contentious was that dealing with the amounts and types of run-offs and leachates (nitrogen and phosphorus) arising from farming activities which find their way into waterbodies.

To quote from the Court's media release on the decision:

The Environment Court has released its decision on appeals against parts of the Proposed Manawatu-Wanganui Regional Council One Plan. There were more than 20 appeals filed with the Court in 2010, but many of the issues raised were resolved by mediation and discussion. Only four topics were taken to hearings before the Court.

The nearly 190 page decision covers those four topics which were dealt with in hearings at Palmerston North and Wellington between March and June this year.

...

Surface Water Quality

The most contentious issue was the control of nutrient (mostly nitrogen) loss through leaching and runoff from fanning operations into streams and rivers. The main problem is that excessive amounts of nutrients, such as nitrogen, getting into waterways will cause a proliferation of pest plants and algal blooms. This leads to the clogging of the waterways, serious oxygen depletion and visual effects. The water will become undrinkable for stock and for humans and the ecosystems of plants and fish in the waterways will be destroyed. The parties representing pastoral interests – Federated Farmers, Fonterra, Ravensdown – and Horticulture NZ, largely agreed on the need for a regime to control nutrient runoff — the differences arose in how best it was to be achieved, and whether sheep and beef farming, and horticulture, should be included in the controls.

The evidence was that about one half of the nutrients presently being washed or leached into the region's waterways by farming and horticulture come from dairy farming, although dairying occupies only a relatively small percentage of the farmed land in the region. The original proposal had been to control only runoff from dairying, but the Court decided that it would be unfair for dairy farmers to be subject to controls when other types of farming were not. It was also obvious that controlling only dairying would deal with only half of the nutrient problem. The Court therefore decided that steps should be taken to bring both irrigated sheep and beef farming, and horticulture, into the nutrient management regime.

The Court also accepted the view put forward by some of the parties that including all sheep and beef farming in the management regime, and a nitrogen trading scheme, had possible merit, although a trading scheme requires further detailed planning. The Court has suggested to the Council that these are matters which could be dealt with by way of a Plan Change in the future.

Some farmers will need to change some practices to get their nutrient losses within the Plan's limits, but the evidence was that in most cases that can be done at acceptable cost.

In the proposed version of the Plan, the lakes in the region's coastal areas, and Lake Horowhenua, were not included in the water management system. The Court has decided that those lakes should be included as the evidence is clear that, particularly for Lake Horowhenua, the water quality is severely degraded and requires concerted attention, although the Court acknowledges that the causes of the Lake's problem are long standing and complex.

The Court's decision will require the redrafting of parts of the Plan and the Court has asked the Council to do that, after consulting with affected parties to the appeals, and to present the redrafted provisions to the Court by the end of October.

With appeals now lodged in the High Court the final version of the Plan will have to await the resolution of those appeals.

"The most contentious issue was the control of nutrient (mostly nitrogen) loss through leaching and runoff from fanning operations into streams and rivers. The main problem is that excessive amounts of nutrients, such as nitrogen, getting into waterways will cause a proliferation of pest plants and algal blooms."

Concluding comments

Freshwater and how it is managed, including who gets access to it and who doesn't, is a highly important and emotional issue for New Zealanders and one which will stay at the forefront of our resource planning and the legislative reform programme for many months and years to come. We will continue to update you on important events as and when they occur. ■

Footnotes

[1]For more information see: www.waikato.govt.nz/laketaupo

[2]http://www.waikatoregion.govt.nz/Community/Whats-happening/News/Media-releases-archived/Regional-council-satisfied-with-Variation-6-decision/

[3]http://www.orc.govt.nz/Documents/Publications/Regional/Water/Plan

[4]http://ecan.govt.nz/our-responsibilities/regional-plans/regional-plans-under-development/lwrp/Pages/summary-commissioner-skelton.aspx

Technology for efficient water quality management & control

Amiad EBS Filters

The largest automatic self-cleaning filter for fine filtration

Amiad SAF Filters

The automatic self-cleaning filter – suitable for more applications than ever

Filtomat AMF² Microfibre filters

Innovative self-cleaning microfibre water filter for treatment as fine as 2 micron

Filtomat MCFM filters

Automatic continuous self-cleaning filter for high flow rates and high dirt loads

Arkal Spin-Klin filters

Reliable, effective self-cleaning SpinKlin® disc technology for clean water

Arkal Spin-Klin Galaxy filters

Unique SpinKlin® disc filtration technology upscaled for high volume handling

Dorot control valves

State-of the-art automatic control valves designed for the most demanding water control requirements

Dorot air release valves

Optimised design for air release even at very high air flow velocities

wsp
water supply products ltd

For further information contact our industrial sales team:

North Island – Mike Stapleton | P: 09 916 0094 | M: 021 475 601 | mstapleton@watersupply.co.nz
South Island – Mathew Morrow | P: 03 348 1293 | M: 021 191 2109 | mmorrow@watersupply.co.nz

The common perception of Auckland motorways when associated with water is "dirty motorways"

AMAzing Water Quality Improvements

Peter Mitchell – Stormwater Asset Manager, Auckland Motorway Alliance and Senior Environmental Engineer (Associate), Opus International Consultants

Introduction

What do Auckland Motorways and water quality have in common? The common perception tends to be of "dirty motorways", however the Auckland Motorway Alliance (AMA) has delivered some AMAzing water quality improvements. This article provides a brief overview of the issues and objectives associated with water quality outcomes and some insight into activities of the AMA that addressed financial challenges while ensuring service levels were maintained and that good healthy environmental and positive water quality improvement outcomes were achieved.

Background

In 2008 the AMA was established to maintain the Auckland motorway network on behalf of the New Zealand Transport Agency (NZTA). The Auckland motorway network is unique, complex, and of national significance and while not big on an international scale, it is very busy and critical to New Zealand's economy. The 240km of network:

- Provides roading connection for 1.5 million people
- Is trafficked by nearly 1 million vehicle movements per day
- Represents about 20% of state highway traffic and 10% of New Zealand's daily traffic

The AMA brings together its partners in a single organisation with common aligned objectives and core values set out in a charter. The key alliance partners are NZTA, Fulton Hogan, Opus, Beca, Resolve Group, and Armitage.

The AMA's purpose is to:

> "The AMA's purpose is to *operate and maintain a connected network for all stakeholders where customers feel informed and are confident that they will get to their destinations comfortably, safely and reliably at all times.*"

Operate and maintain a connected network for all stakeholders where customers feel informed and are confident that they will get to their destinations comfortably, safely and reliably at all times.

It's vision is:

To provide informed customers and stakeholders with the positive legacy of a world class, safe, efficient, and optimised stormwater management asset, which delivers an appropriate level of service, and best practicable option to avoid, remedy or mitigate adverse environmental effects.

The AMA's mission is:

Zero harm to our people, environment and business.

SH16 Central Motorway Junction – Newton Stormwater Treatment Pond (Photo courtesy of Peter Mitchell)

The AMA Way

The AMA is placing significant emphasis on stormwater management. Being such a heavily trafficked network it is essential that the motorway is free of surface water to reduce risks like aquaplaning, and that the motorway is not impassable because of flooding. Additionally, stormwater runoff from the motorway can include pollutants or contaminants like sediments, litter, debris, oils, and heavy metals such as copper, zinc and chromium. The NZTA has many Resource Consents for stormwater discharge that the AMA must manage to ensure legal requirements are satisfied. Water quality, pollution, erosion, and protection of the receiving environment are important factors of compliance and positive environmental outcomes.

Prior to the AMA, stormwater activity at Auckland's Motorways was delivered reactively. By delivering proactive work (cyclic and periodic), and through the alignment and streamlining of activity (e.g. multiple workstream activities delivered under single traffic closures), and delivering most maintenance activity at night (to minimise network efficiency issues), the AMA now spends less than 10% of the stormwater asset budget on reactive work. The challenge for the AMA is to continue to maintain and deliver the assets while reducing overall costs.

Strategic Goals and Actions

The AMA stormwater strategy and activity plan includes a number of goals and activities such as:

- Delivery of the Stormwater Management Assets focussed to reduce the incidence of flooding and to deliver environmental compliance
- Improve asset knowledge and data to enable improved asset management and outcomes
- Deliver AMA Levels of Service agreed with NZTA and seek to change levels of service where there are opportunities to improve value for money outcomes
- Measure and improve asset performance (e.g. quality, quantity, condition), with respect to the level of service for water quality

"It rains a lot in Auckland and it is critical the motorway network remains safe during wet weather. To improve motorway reliability and safety it is important that stormwater assets are well maintained and that appropriate activities are delivered to reduce flooding."

- Manage risk registers and prioritise improvement needs for all levels of service delivery
- Optimise expenditure and balance programmes of works to reduce the life costs, and develop models so that various funding scenarios can be linked to levels of service
- Reduce the cost of maintenance by innovation in design, materials and work practices
- Robust and continuously improving forward works program, and a resilient 10 year rolling forward work programme
- Stakeholder and customer requirements and perceptions are included in asset management decisions by a good understanding of needs
- Have the 'right' people – qualified, trained, experienced, skilled and knowledgeable
- Manage a register of ideas and innovations, and pursue 'additional' strategic improvement opportunities when timing, resources, and funding becomes available

Auckland Motorway Stormwater Management Assets

The Auckland Motorway stormwater management asset includes all elements of a traditional drainage collection and conveyance network such as slot drains, catch-pits, manholes and pipes; waterway and network crossing culverts; pump stations and soakage disposal systems, etc. The AMA also delivers the highest concentration of stormwater treatment devices (and growing) of any network in New Zealand. This includes:

- 93 stormwater treatment ponds (dry, wet, and wetlands)
- 34 Sandfilters (Washington, Austin, and bespoke)
- 61 Sedimentation/detention vaults (including NZs largest at Grafton Gully measuring 85m long x 10m wide x 3m deep)
- 21 StormFilter Vaults containing a total of 416 activated siphon cartridges (zeolite, perlite and activated carbon media)
- Tunnel Spill containment systems
- Catchpit filter systems
- Biodetention assets
- Extensive treatment swales (natural, standard grass, and planted)

Of note is that of the more than 4 million square metres of motor-way pavement, approximately 85% is paved with Open Graded Porous Asphalt (OGPA). Although not a traditional stormwater treatment asset, OGPA has a high inherent treatment capability (acting like a permeable pavement). Runoff from OGPA surfaces receives good pre-treatment that helps to improve the quality of runoff (i.e. it is a valuable part of the treatment train).

Forward Works for Stormwater Assets

AMA planned forward work activities for the stormwater management devices is primarily driven by proactive, timely, and responsible monitoring to identify the scale and priority of maintenance needs. Typically, stormwater management devices are monitored

quarterly from the time of last activity that verified good functionality either by monitored observation or by the delivery of maintenance.

Most stormwater treatment devices are less than 15 years old and are still in a reasonable condition. Optimal operational activity needs of stormwater treatment devices are still being established and refined. It appears that the rate of deterioration in assets, such as ponds, is much greater than for more traditional assets such as catchpits and sedimentation vaults. Some renewals will be required in the shorter term than may have been intended by design. Pond landscaping, for example, provides important ecological and water quality function but requires a much higher level of maintenance activity than say the pond inlet and outlet structures.

Surface Flooding and Water Quality

It rains a lot in Auckland and it is critical that the motorway network remains safe during wet weather. To improve motorway reliability and safety, it is important that stormwater assets are well maintained and that appropriate activities are delivered to reduce flooding. Slot drain and catchpit cleaning activities also support the delivery of compliance and water quality improvement by removing contaminants and can help to enhance the longevity of stormwater pond forebays (e.g. improved at-source control).

To enable the smart delivery of operational activity needs, individual risk locations at Auckland Motorways have been profiled and prioritised based on the likelihood of blockage and flooding and the consequence of this. Benefits of improved network efficiency include a reduction in pollutant generating potential. Despite the good operational activities to improve surface flooding and pollution, future incidents will occur (e.g. storms and unexpected blockages). Being prepared with the right resources to deliver activity needs is most important.

Top left – SH1 Alpurt B2 – Waiwera Stormwater Treatment Pond, Top right – SH18 Tauhinu Headland StormFilter Vault – 108 ZPG Cartridges, Above left – SH1 East Tamaki – Inside a freshly cleaned Sedimentation Vault, Above – SH18 Upper Harbour Highway Causeway Lagoon Pond (Photos all courtesy of Peter Mitchell)

"Having the right team (best for network), helps to ensure that good stormwater quality outcomes can be achieved."

SH1 Papakura Stormwater Treatment Pond (Photo courtesy of Peter Mitchell)

Water Quality Improvements

The AMA deliver a wide range of activities that all contribute towards water quality improvement outcomes. Some important factors include:

- Team and Resource
- Data
- Standardised Operation and Maintenance
- Environmental Controls
- Pollution and Contaminant Removal
- Response to Spills
- Landscaping Improvements
- Training and Education
- Innovations
- Capital Project Inputs
- Promulgation

Team and Resource

Having the right team (best for network), helps to ensure that good stormwater quality outcomes can be achieved. Timely and informed intervention with skilled and properly equipped staff to do the right activity at the right time, safely and effectively, while providing the right outcomes helps to achieve good value for money. This includes:

- Specialist skills and knowledge
- Availability of specialist tools and resources (e.g. iPad, and Juno systems for automated data, and plant such as combo trucks that flush, vacuum and recycle)
- Great customer and stakeholder relationships, partnerships, and proactive collaborative engagement across industry (e.g. Auckland Council, Auckland Transport, University of Auckland, Sustainable Coastlines, special interest groups, etc)
- Taking genuine ownership – Ownership delivers great outcomes

Data

Good available, accurate, and accessible data and data management systems is the foundation of good asset management. The AMA:

- Ensures that the right level of service is delivered. The AMA has developed a comprehensive database of all stormwater treatment device assets that is presented in its GIS based AMA Spatial Viewer
- Activity needs are programmed and logged to the AMAtrac activity Level of Service reporting system to help ensure that timely delivery of compliance for stormwater quality management occurs at the right assets
- Monitoring of selected treatment devices includes sediment and water quality sample collection, lab testing, and data analysis for the purpose of performance capability evaluation as well as determining the optimal contaminant disposal options
- Good monitoring and whole of life data capture and analysis enables good decision making (related to holistic performance including water quality) and improved value for money outcomes

Standardised Operation and Maintenance

Standard monitoring and exception-based reporting ensures that the right operational activities (cyclic, periodic, reactive, renewal, improvement, new asset) are proactively and safely undertaken at the right time ('just in time' intervention) using the right resources ('fit for purpose'). The AMA way includes:

- Standardised and simple procedures enable familiarity, efficiency, and consistency of delivery, and empowerment to deliver better quality outcomes
- The AMA has developed innovative asset specific schedules for the delivery of consistent monitoring of the treatment devices that enables automated condition rating of the critical elements of the devices
- "Boots to suits" field guides facilitate operator activities, helping the AMA to secure increased confidence in the delivery of forward work needs and giving confidence that water quality management is responsibly delivered
- Compliance monitoring by use of CS-VUE online environmental management and compliance system, with linkage to activity needs (delivery and reporting) as well as proactive regulatory compliance reporting

Left – SH16 Grafton Gully Sedimentation Vault Forebay Maintenance, Right – Stormwater treatment assets help to capture contaminants and manage pollution (Photos courtesy of Peter Mitchell)

Environmental Controls

The AMA has a developed a network specific environmental management plan that includes principles and procedures for improved delivery a number of 'routine' activities that can improve the pollution and water quality outcomes such as:

- Environmentally robust procedures for a number of routine activities including emulsion & paving, priming and painting, abrasive and water blasting, refuelling, stockpiling, and concrete and asphalt cutting, etc
- Contaminated land activity procedures
- Good erosion and sediment controls
- Environmental audits of activities

Pollution and Contaminant Removal

The AMA currently collects about 3,000 tonnes per annum of road derived contaminants that would otherwise end up in the environment. It is also important to NZTA and AMA that contaminants collected are responsibly managed and safely disposed of. AMA uses a number of methods to do this including:

- Litter runs and sweeping at debris hotspots
- Routine maintenance of stormwater treatment devices
- Cyclic catchpit sump cleaning (exception based at critical assets)
- Regular maintenance of soakage disposal assets (60+)
- Litter and pollution warning letters (to recidivist prone areas
- Identification of fly tipping offenders
- Enforcement by securing prosecutions

Response to spills

Spills at Auckland Motorways network present a significant risk to the safety of people and the environment. Recent spills have included potentially harmful oils, sewerage, and milk powder. Despite much of the stormwater treatment system incorporating containment capability, the AMA way helps good outcomes by:

- Being highly responsive to containing incidents and making good in a timely manner (rather than costly and time consuming pollution clean ups)
- Specially trained operators in the procedures and requirements for incident management, who are equipped with a range of tools and resource (e.g. spill kits, safety equipment and plant that enables captive water cleaning techniques, etc) to ensure needs are delivered as best for needs
- Good collaborative relationships e.g. specialist contractors, the Auckland Council emergency response team (e.g. significant spills), Watercare Services Limited (e.g. burst sewer), and Fire Service (e.g. tunnel foaming), etc

Landscaping Improvements

Good landscaping helps to manage runoff that can otherwise cause erosion, flooding, and pollution. Positive landscape activities by AMA include:

- Carefully managed edge spraying with environmentally approved agrichemical products (e.g. to manage edge creep) Improved weedeating and mowing practices (resources and definition of go/no-go areas)
- Good proactive cyclic and periodic attention to vegetation
- Landscaping Specialists for Ponds
- Planted Swales (rather than traditional grass swales)
- Delivery of focussed landscape planting and mulching activity to help improve the quality of stormwater discharge
- Inputs to the NZTA Landscape Guidelines to help ensure that appropriate water quality outcomes and whole of life operational objectives and values are represented

Training and Education

For both the NZTA and the AMA, the safety of road users and operators at all levels is of utmost importance and a critical component of success. For the AMA it is important that all staff are culturally aligned with the alliance's direction and vision, and only suitably qualified and trained personnel are used. AMA activity includes:

- Training and education on asset function and operational procedures help to ensure clarity and consistency of activities.
- "Boots to Suits" – All activity must be commonly understood for optimal empowerment (e.g. language and medium of instructions should be clearly understood). Using specialised engineering terminologies is often meaningless to 'boots' operators, and 'suits' awareness of what 'actually' happens often needs translation to successfully close the asset lifecycle gap for stormwater asset operational needs.
- Brown Bag Lunches – Informal weekly lunch lessons to share knowledge and ideas that educate the wider team of lessons and asset specific activity needs.
- Presentations such as conferences (e.g. Stormwater and NZIHT), publications (e.g. AMA informer, coastal news, journals), and guest lecture (e.g. University of Auckland), etc., to share ideas with the industry about the AMA way of delivering stormwater management and improving water quality outcomes.
- Safety Training – New methods such as SafeStart changes behaviour towards looking for risk patterns and application of critical error reduction techniques. This technique enables continuous improvement to the way all activity is delivered. SafeStart takes into account not only the safety of people but also the environmental and water quality outcomes.

Innovations

Innovations and initiative projects delivered by AMA help to improve water quality including:

- Standardised Operational Monitoring and Maintenance schedules
- Planted Swale Trials to identify suitable plant species (resilient and low maintenance)
- Algae management trials
- New Zealand's first bifurcated wet pond and study of Floating Vegetated Island water quality performance capabilities
- Automation of the treatment and spill containment assets at the Auckland Harbour Bridge
- Sediment accumulation monitoring practice
- Road derived sediment reuse
- Improved forecasting (tides and weather) that can impact on water quality, as well as 'events' that result in increased contamination at our network, e.g. rock concerts when litter spikes occur
- Sandfilter media trials to improve reliability of asset function and quality of outcomes
- Safety improvements such as creating safe access that enables timely delivery of routine and reactive needs

Capital Project Inputs

Auckland Motorways are a current focal point of many of NZTA's nationally significant projects (e.g. SH20 Waterview Connection; SH16 Causeway Upgrades; SH1 Newmarket Viaduct, etc), which further contributes to the scale, importance, and complexity of good management and responsible delivery of the stormwater assets. AMA actively engages on NZTA Capital Projects to positively influence legacy outcomes, including:

- Producing an Operation and Maintenance Guideline for the planning, design and construction of Capital Projects. This document outlines the issues, values, opportunities, and handover needs that influence improved operations and water quality outcomes
- Comments on planning, proposed designs and construction based on our knowledge of whole of life maintenance issues of existing network assets
- Handover inspections to help operational familiarity

Promulgation

The promulgation of ideas, innovations, and lessons of 'fit-for-purpose' activities by the AMA help contribute towards water quality improvement. If every stormwater asset owner, regulator, planner, manager, contractor, consultant, etc, takes a single idea for application then a positive difference to global water quality can be expected. We can all make a difference.

Summary of AMAzing Water Quality Improvement Outcomes

The Auckland Motorway Alliance successfully delivers a diverse range of activities that contribute towards positive environmental and stormwater quality outcomes, including: having a great and empowered team; improved knowledge and data; asset and activity standardisation; robust and continuously improving forward works programmes for delivering appropriate and meaningful levels of service; environmental compliance delivery; proactive pollution and contaminant management; landscaping improvements; training and education; improved preparedness; innovations; inputs

Top left – SH1 to SH16 Link – 2008 Milk Powder Spill, Above left – SH16 Causeway 23rd January 2011 – 6 tonnes of coastal debris cleared following morning tide (Photo courtesy of Peter Mitchell), Above right – SH1 Bifurcated Stormwater Pond – Silverdale Floating Vegetated Island Trial

to capital projects; promulgation of ideas; and great collaborative relationships. These all help to deliver an AMAzing positive difference to the way AMA deliver the Auckland Motorway network and achieve positive environmental and water quality outcomes.

The AMA has already achieved value for money, delivering $23M in cost savings for the NZTA. Recent success and recognition includes winning the Roading New Zealand Supreme Roading Excellence & Best Asset Management Practice Awards, and is one of the four finalists in the 2012 Australasian Alliancing Awards. In a few short years the AMA has delivered a quantum improvement in the stormwater asset management of Auckland's motorways, yielding big benefits for the environment and to the people of Auckland. ■

"If every stormwater asset owner, regulator, planner, manager, contractor, consultant, etc, takes a single idea for application then a positive difference to global water quality can be expected. We can all make a difference."

Faecal Source Identification Using Faecal Sterol Analysis

Brent Gilpin, Susan Lin, Andrew Chappell and Meg Devane – Institute of Environmental Science and Research, Christchurch

There are a range of water quality monitoring tools which can be used to identify the source of elevated levels of *E. coli* or enterococci in a water sample. One approach is the measurement of faecal sterols in a water sample. Faecal sterols are a group of C27-, C28- and C29- cholestane-based lipids found mainly in animal faeces.

The sterol profile of faeces depends on the interaction of three factors. The animal's diet determines the relative quantities of sterol precursors (cholesterol, 24-ethylcholesterol, 24-methylcholesterol, and/or stigmasterol) entering the digestive system. Animals also differ in their endogenous biosynthesis of sterols. For example, cholesterol is an important requirement for humans, and if there are insufficient levels in the diet, humans will biosynthesise cholesterol.

Finally, the anaerobic bacteria in the animal gut biohydrogenate sterols to stanols of various isomeric configurations. Since the bacteria in animal guts differ between species, the relative levels of sterols they excrete also differs. The sterol cholesterol can be hydrogenated to one or more of four possible stanols. In humans, cholesterol is preferentially reduced to coprostanol where it constitutes 60% of the total sterols found in human faeces. Humans are estimated to excrete between 200–700 mg/day of coprostanol.

"Since the bacteria in animal guts differ between species, the relative levels of sterols they excrete also differs."

In the environment, however, cholesterol is predominately reduced to cholestanol. Similarly, plant-derived 24-ethylcholesterol is reduced to 24-ethylcoprostanol and 24-ethylepicoprostanol in the gut of herbivores, whereas in the environment it is primarily reduced to 24-ethylcholestanol. As a consequence, analysis of the sterol composition of faeces can generate a sterol fingerprint, which differentiates human and animal faeces.

The analysis of sterols in water can confirm the presence of faecal material, and identify the dominant sources of that faecal input. The absolute levels of sterols, particularly coprostanol is indicative of faecal pollution, but to determine sources, comparisons of ratios are more effective. Table 1 lists key ratios and the interpretation guidelines. Ratios F1 (coprostanol/cholestanol) and F2 (24-ethylcoprostanol/24-ethylcholestanol) are typically >0.5 in human and ruminant faecal material. In wildfowl and canine faeces these ratios may not exceed 0.5. Ratios H1 to H4 are all indicative of human faeces when thresholds are exceeded, and are based around elevated relative levels of coprostanol. Ratios R1–R3 are indicative of ruminant faeces, while high ratios P1 (24-ethylcholesterol/24-ethylcoprostanol) suggest either plant decay, or a diet of plant material such as seen in wildfowl. Wildfowl are also indicated by the examination of ratios A1 and A2 which, when both exceed the specified levels, indicates a wildfowl source of sterols.

Table 1 – Sterol Ratios used for faecal source identification

Ratios indicative of faecal pollution (either human or animal)		Thresholds for each ratio
F1	coprostanol/cholestanol	>0.5 indicative of faecal source of sterols
F2	24-ethylcoprostanol/ 24-ethylcholestanol	>0.5 indicative of faecal source of sterols
Human indicative ratios		
H1	%coprostanol	Ratio >5–6% suggests human
H2	coprostanol/(coprostanol+cholestanol)	Ratio >0.7 suggests human
H3	coprostanol/ 24-ethylcoprostanol	Ratio >1 suggests human source
H4	coprostanol/(coprostanol+24-ethylcoprostanol)	Ratio >0.75 suggests human
Ruminant indicative ratios		
R1	%24-ethylcoprostanol	Ratio >5–6% suggests ruminant
R2	%coprostanol/(coprostanol+24-ethylcoprostanol)	Ratio <30% suggests ruminant
R3	24-ethylcholesterol/24-ethylcoprostanol	Ratio <1 suggests ruminant
Avian indicative ratios		
A1	24-ethylcholestanol/(24-ethylcholestanol+ 24-ethylcoprostanol+24-ethylepicoprostanol)	A1 Ratio >30% suggests avian source AND A2 Ratio >67% suggests avian source
A2	cholestanol/(cholestanol+coprostanol+epicoprostanol)	
Plant indicative ratios		
P1	24-ethylcholesterol/24-ethylcoprostanol	Ratio >4 suggests plant decay

To illustrate the results that can be obtained from faecal sterol analysis of water samples we present in Tables 2 and 3 the results obtained from analysis of seven river water samples. All seven samples contained elevated levels of the faecal indicator *E. coli*. Faecal sterol analysis was performed by filtering up to 4 L of water onto glass fibre filters. Samples were spiked with a deuterated internal standard and refluxed with 6% methanolic KOH for 4 hours. The supernatant containing the hydrolysed sterols was decanted with a washing step for the flask. Supernatant and wash were combined and sterols partitioned into hexane and then evaporated to dryness. Each sample was derivatised, a system monitoring compound added, and analysed by gas chromatography with mass spectrometric detection. Each sterol and stanol detected is expressed as parts per trillion (ppt), which is equivalent to ng/L.

The levels of total sterols in each sample ranged from 256 up to 56,000 ppt. We normally require at least 2,000 ppt of total sterols in a sample to proceed with ratio analysis, which is the case in rivers A to F. Rivers A to D exceeded ratios F1 and F2 which is consistent with animal or human faecal contamination. Rivers A and B are consistent with sterols in the water being from a human source. The human indicative ratios are all based on coprostanol – the dominant sterol in human faeces. Ratios H1–H3 all exceed their thresholds. While the fourth human ratio, H4 is not greater than 0.75, it is close to reaching this threshold. Together, these ratios are strongly indicative of a human source for Rivers A and B.

Rivers C and D are consistent with a ruminant source of sterols with ratios R1–3 exceeding the thresholds. These ratios are based around levels of 24-ethylcoprostanol which dominate in ruminants. Sterols in the human contaminated water exceeded one or more of the ruminant ratios, and sterols in the ruminant contaminated water exceeded one or more of the human ratios. Typically these incongruent ratios are based on the percentage of coprostanol (H1) or 24-ethylcoprostanol (R1) which can be elevated in both human and ruminant sources. However, it is the combination of ratios which is most important.

Rivers E and F are not consistent with either human or ruminant faecal contamination. The elevated levels of *E. coli* are, however, consistent with a wildfowl source of sterols with ratios A1 and A2 both exceeding thresholds in river E, while for river F, ratio A2 doesn't quite reach the threshold. This is something we have found previously, and revision of this threshold may be warranted. These two samples are also consistent with a plant source of sterols. Environmental waters are complex environments and may contain mixed sources of pollution, and unrelated backgrounds of plant material. Fortunately, the high levels of coprostanol and 24-ethylcoprostanol in human and animal faeces means that these sterols tend to dominate when present.

River G illustrates that, despite elevated levels of *E. coli*, some samples do not contain sufficient sterols for ratios to be calculated. While ratios could be calculated based on very low levels of sterols it would not be valid. The conclusion, therefore, is that there are insufficient sterols in the sample to make a source determination. Since the sample does contain high levels of *E. coli* (1,100/100ml), an additional conclusion is that it is not consistent with fresh or recent faecal pollution from human or ruminant sources. To resolve how a sample might contain high levels of *E. coli*, but very low sterols requires additional investigation.

Table 2 – Sterol analysis of seven rivers. Presented are *E. coli*/100ml, volume of water analysed and levels of total sterols and coprostanol in parts per trillion.

River	*E .coli*	Volume	Total sterols	Coprostanol
A	450	4L	6978	996
B	400	4L	14950	1602
C	900	2L	21768	1184
D	1600	2L	56600	2867
E	2380	1.65L	2483	19
F	700	4L	6690	168
G	1110	1.7L	256	7

Table 3 – Ratios of sterols in seven rivers

River	Faecal Ratios		Human Indicative				Ruminant Indicative			Avian Indicative		Plant
	F1 >0.5[a]	F2 >0.5	H1 >5	H2 >0.7	H3 >1	H4 >0.75	R1 >5	R2 <30	R3 <1	A1 >30	A2 >67	P1 >4
A	**3.89**	**4.07**	**14.3**	**0.80**	**2.33**	0.70	**6.1**	70	3.70	19	20	3.70
B	**6.21**	**6.09**	**10.7**	**0.86**	**2.19**	0.69	4.9	69	4.45	14	14	**4.45**
C	2.15	4.46	5.4	0.68	0.15	0.13	**35.3**	**13**	**0.37**	17	29	0.37
D	2.61	2.11	5.1	0.72	0.14	0.12	**36.3**	**12**	**0.34**	28	25	0.34
E	0.23	0.29	0.8	0.19	0.90	0.48	0.8	48	33.9	**73**	**76**	**33.9**
F	**0.65**	**1.62**	2.5	0.40	0.75	0.43	3.4	43	9.75	**36**	57	**9.75**
G	~~1.00~~	~~1.17~~	~~2.7~~	~~0.50~~	~~1.00~~	~~0.50~~	~~2.7~~	~~50~~	~~11.0~~	~~43~~	~~47~~	~~11.0~~

[a]*thresholds for each ratio*

The examples above were all river water, but the method works equally well on saline waters. Water samples can be taken in the same manner as for other water quality tests, however, larger volumes are often required. Sterols are hydrophobic in nature and preferentially partition to solids, with 70–90% of sterols in water associated with particulates. In water with high particulates and heavy contamination, analysis of 100 ml may be sufficient. In groundwater samples it may require up to 50 L of water. In most river or sea samples we recommend the collection of 4 L of water. This may all be filtered, or a smaller volume may be tested if it causes filters to block up with particulates.

It is important to be aware of contamination issues when collecting water for faecal sterol analysis. It is advisable to wear blue nitrile gloves that are free of cholesterol as human handling may contaminate the water sample. Sampling buckets should be well rinsed between sampling sites, with water from the site about to be sampled. Water samples for sterol analysis can be stored at 4°C for up to a week before analysis, or the entire sample can be frozen indefinitely. Storage of large volumes of frozen water can be an issue for some people, so samples can also be filtered onto Whatman Glass Microfibre filters (GF/F 47mm Cat No 1825 047), and the filters frozen until analysis. Both strategies allow traditional bacterial analysis to be undertaken before deciding which samples to analyse. It also allows samples from multiple days or weeks to be collected and then couriered and processed together.

In general, targeting samples with higher levels of *E. coli* or enterococci for analysis is more useful. Not only are these the samples which usually are of most interest, but they can have higher levels of sterols. However, this is not always the case. We have measured very high levels of sterols in samples with very low indicator bacteria and vice versa. This probably reflects the sources of sterols, and may also reflect variation in removal or inactivation rates of sterols and bacteria as they move through the environment. Fresh human or ruminant faecal pollution in water, will, however, generate high levels of sterols with distinctive ratios.

This is, perhaps, the most time consuming and expensive of the faecal discrimination tools offered by our laboratory ($450 + GST per sample if ESR is sent the water for filtering, or $375 + GST per sample if an external laboratory performs the filtering). If our laboratory is notified in advance, and there are sufficient samples for a batch to be analysed, results can be achieved within 10 working days. Fifteen to 20 days is more standard, however.

Like any water testing, decisions should be based on the analysis of not just a single sample, but multiple samples. Whether that is over multiple days, multiple weeks or longer, depends on the situation, and possible sources. A single sample might be sufficient to show a leaking sewer, for example, but not to show that a sewer doesn't leak. Analysis should also include thorough site inspection, review of possible sources and for greater confidence, inclusion of other tests such as the detection of PCR based DNA markers of faecal pollution or detection of other chemicals such as fluorescent whitening agents.

For further information please visit www.waterquality.org.nz or email brent.gilpin@esr.cri.nz ■

The Impact of Stormwater Discharge – What Does the Future Hold?

Chris Pepper, Senior Water Engineer – GHD

It has long been recognised that urban stormwater discharges contain pollutants that are harmful to the environment. Responses to remedy or mitigate these discharges were developed by the Auckland Regional Council, and by the roads industry through the Road Controlling Authority (RCA) forum. However, there are new trends emerging on the scene in New Zealand that could have potential implications for stormwater practitioners.

"It has long been recognised that urban stormwater discharges contain pollutants that are harmful to the environment."

The work of the Land and Water Forum, in conjunction with the Ministry for the Environment, has resulted in funding being made available for cleaning up some of our water bodies that are most at risk. Although the major focus of this funding is on the effects of agricultural activities, the effects of urban discharges cannot be ignored. For instance, it has been recently reported (Manawatu Standard, 2 October 2012) that 90% of the phosphorus reaching Lake Horowhenua in the Manawatu region is from Levin's stormwater discharges. This means that whole of catchment impacts must be considered in order to achieve the maximum improvements to the water quality in our lakes and rivers.

We know that fine sediments (particle size less than 63 microns) are a major issue for our waterways. Much of the copper and zinc found in road runoff is bound up with this fine sediment. However, work undertaken for Auckland Transport would suggest that conventional catchpits or sumps allow a considerable amount of copper and zinc to be discharged in to Auckland's harbours which is accumulating yearly.

So what is to be done about this? The work undertaken by Auckland Transport, who are involved the development of an insert – the 'Tetra Trap' – that can be installed in sumps and catchpits to capture much more sediment is one such whole of catchment solution. With testing showing that not only more sediment is captured, but that the concentrations of copper and zinc were generally improved, as are the capture rates of fine sediment.

Phosphorus and other nutrient removal systems for stormwater have been developed in the US. These generally take the form of improved materials used for the absorption of phosphorus and nutrients, such as replacing the sand in sand filters with absorptive material.

Advanced modelling software tools that collate data and allows whole of catchment effects to be estimated are also available. These can also be used to develop and optimise management plans for catchments. The use of such tools is likely to become more prevalent in the future.

It is impractical to think that all sumps and stormwater discharges are going to be treated in the near future. But if our thinking is to change from 'remedy and mitigate' to avoidance, as encouraged by the Resource Management Act, the thrust of our long term planning for urban stormwater should be developing programmes of work that aim for prevention of effects rather than cure. ■

Improving Treatment to Improve Treatment: How a New Wastewater System Saved Soyo Hospital

Ted Kulongoski – Orenco Systems, Inc.

Taking Care of the Caretaker

Governmental leaders in Angola, Africa have taken action. Recently, they partnered with a group composed of a consortium of oil and gas companies and local stakeholders called Angola LNG to identify priority rehabilitation projects across the country. The projects take a much-needed step toward improving the livelihoods and quality of life of Angolans. The expansion and renovation of Soyo Municipal Hospital was labeled as one of these projects, in hopes of increasing the hospital's capacity so it could continue to provide sufficient medical services to the local community.

During the renovation of Soyo Municipal Hospital, a 70-bed facility and one of the main providers of healthcare and emergency medicine to the citizens of the Soyo Community, project managers identified numerous wastewater treatment issues due to the hospital's remote location. A new and more reliable treatment system was necessary to keep the hospital running effectively.

Centrally located in the town of Soyo and surrounded by residential homes, the hospital sits on fine, sandy soil and has a high water table during the rainy season, making the site unsuitable for a standard septic tank and drainfield. The hospital originally received a proposal for a Moving Bed Biofilm Reactor (MBBR) with inlet bar screen, flow equalization chamber, diffused aeration system, scum and sludge transfer systems, sludge digester chamber, and chlorine disinfection chamber.

Although MBRs are an effective wastewater treatment system, they require a reliable source of electricity, a ready supply of chemicals, and regular operator attention. These requirements can pose difficulties in a remote location. Angola LNG special projects construction superintendent Gary Bridier had concerns. Bridier had worked in Africa for more than 20 years and knew that there had to be a more appropriate and sustainable solution for the hospital's wastewater treatment plant than what he'd seen so far.

On to Plan B

In June of 2011, Bridier began to research alternative wastewater treatment technologies. His search led him to Orenco Systems, a leader in the decentralized wastewater industry, which has decades of experience supplying wastewater equipment to Africa and other parts of the world. The recommended treatment system for the Soyo Municipal Hospital consisted of:

- Two (2) 11.9-metre-long T-Max primary tanks
- Two (2) 10.7-metre-long AdvanTex AX-Max textile treatment units
- One service building for system controls and UV disinfection units

Once Bridier saw the system in action and weighed his options, the choice was clear. The order was placed in July and, even with custom specifications and manufacturing, the system arrived at the construction site

in November of 2011. Installation began immediately.

AdvanTex in Action

The AdvanTex AX-Max wastewater treatment system receives effluent from Soyo Municipal Hospital, which includes wastewater from toilets, sinks, showers, laundry, laboratories, kitchen, and other related hospital facilities. The design flow rate for the system is 40,000 litres/day. Effluent from the hospital is pumped into two primary tanks (50,000 Litres each) and flows by gravity to two secondary treatment units. These four units were installed five feet below grade to reduce the visual impact of the wastewater treatment system, while still offering optimal access for any necessary maintenance work.

"During the renovation of Soyo Municipal Hospital, a 70-bed facility and one of the main providers of healthcare and emergency medicine to the citizens of the Soyo Community, project managers identified numerous wastewater treatment issues due to the hospital's remote location."

Effluent from the treatment system is pumped through two UV Pure Hallet™ 30 ultraviolet disinfection units. Because of the high-quality of the effluent, the Hallett 30's maximum flow-through rate of 30gpm (113.5L) was possible. From the UV units, the disinfected effluent (tertiary treated wastewater) flows into a distribution box, where gravity directs it into four infiltration basins. Each infiltration basin is sized to accommodate 20,000 Litres. Since the AX-Max requires less than 2kWh per, 3,785L treated, the intermittent power needed for the treatment system does not unduly burden the generator installed at the hospital.

An onsite service building was constructed next to the treatment system to provide a secure facility for installing system controls and UV disinfection units.

Above – Treatment units installed below ground for reduced visual impact, Right – Control panel installed in secure onsite service building

The control panel for the system has remote telemetry capabilities, and includes a touch screen on the outside of the control panel programmed in both English and Angolan Portuguese. The touch screen provides an uncomplicated user interface for viewing system data logs, as well as for real-time monitoring or adjusting of the system's operating settings, including its liquid level sensors, pumps, and UV disinfection units. All TCOM panels can be connected to a landline, cellular service, Internet network, or satellite service, allowing technicians at Orenco's headquarters in Oregon, U.S.A. to assist in real-time system monitoring, operation and maintenance, and troubleshooting.

A Successful Transplant

The Soyo Hospital project and installation involved a great deal of coordination. From shipping issues to customs paperwork to language translations, many pieces came together to complete this project successfully. Installation documents and touch-screens for the control panels were provided in both Portuguese and English, and the system was shipped mere weeks after the purchase order was received. Even beyond the successful coordination of logistical details, any technical concerns and other issues were addressed and resolved, taking this project from a challenge to a conquest with very few hiccups. After two-and-a-half months of installation and testing, the AdvanTex system was fully functional at the Soyo facility. Angola LNG can now continue their renovation of the Soyo Hospital with less to worry about – keeping them on track to improve the local community. ■

No Single Way to Engage with Communities

Sarah Munro, Jacki Byrd (Contractor), Kristen McGavock, Chrissy Henley – Auckland Council

Introduction

Auckland Council is a partner in a range of community engagement programmes aimed at improving water quality. Each of these programmes is unique and is tailored to suit the needs of local communities. This means that the ethos, techniques employed, scope and scale of each programme varies in accordance with the context of each area. The diversity of programmes highlights there is no single right way to address water quality issues through community engagement programmes. A key feature of programmes is that they are flexible and have the ability to respond to new challenges and opportunities as they arise. This article presents an overview of these different approaches. Four examples are included – Project Twin Streams, Wai Care, Sustainable Catchments and Stormwater Streamside Restoration Projects.

Project Twin Streams

Project Twin Streams (PTS) is a 10 year project that works with communities to restore the streams in their local neighbourhoods. The project has used community engagement to address issues in the Henderson Creek catchment such as flooding, poor water quality, lack of awareness of streams and community disconnection from the natural environment. The Council and communities of the catchment work together in a long term partnership. PTS includes riparian restoration, community development, land acquisitions and the creation of walk and cycleways. The use of art to engage diverse communities is also a strong feature.

"Deliverables in these contracts have been refined over time requiring ongoing flexibility and strong relationships between Council staff and community organisations."

Project Twin Streams recognises the need to use a diverse range of engagement techniques and uses the following key engagement strategies: joint vision, community contracts, creative engagement, and education, communication and behaviour change.

Joint Vision: A joint vision – "*working together for healthy streams and strong communities: creating a sustainable future*" – was developed through in-depth consultation with the communities of the catchment.

Community Contracts: Project Twin Streams has contracts with four local organisations who in turn engage more than 30 schools and 150 community groups in restoration and environmental education activities. Community contracts recognise that local organisations can be more effective than the Council at engaging 'their own'. Deliverables in these contracts have been refined over time requiring ongoing flexibility and strong relationships between Council staff and community organisations.

ZEAL West Auckland Youth Group at Falls Park, Henderson at a Planting and Junk Art event organised by Community Waitakere in June 2010

Creative Engagement: A consistent finding is that people of all ages connect with the environment through creative processes and that the kinds of thinking and feeling that emerge through creative processes are likely to leave a lasting impression – more than planting a tree or reading about native fish habitat. Community art projects are created to mark project areas adopted by particular community groups. Popular activities aimed at young residents include stream-themed rap videos, storybooks, dance and murals. PTS uses creativity to engage 'hearts and minds' and communicate the value of the stream environment across a diverse community.

Education, Communication and Behavior Change: PTS recognises that people are more likely to change their behaviour when they understand the issues and are meaningfully involved in identifying solutions. Key messages are communicated via a range of media including newsletters, websites, books, art installations, social networks, competitions and photo logs. Examples of practical education ventures include community edible gardens, Te Pa Harakeke o Te Iwi native flax weaving collection, the household sustainable living programme and community cycle and walking events.

The PTS research outlines examples of social capital outcomes including a reduction in the vandalism of trees planted through the project and an increase in the number of people collecting rubbish along the stream bank. There is also a stronger perception of the community's ability to influence Council decisions than is in evidence across the wider community suggesting that PTS is building cohesion, resilience and trust. The physical walk and cycle ways connect people with their streams, town centres, workplaces, schools, public transport and parks.

Through a community development approach combined with creative engagement, a sense of fun and growing capacity in the community, Project Twin Streams is winning over the hearts and minds of the generations living in the catchment.

"Active techniques to empower public engagement in addressing water quality can provide diverse benefits- from community connectedness to the natural environment to improved stormwater performance."

Wai Care

Wai Care is a water quality monitoring, education and action programme for community groups, individuals, businesses and schools within Auckland guided by the vision *"Together for healthy waterways"*. Wai Care is about all of us doing our bit to take care of local waterways and catchments. The purpose of the programme is to support and enable local community groups, schools and individuals to be active in the protection, health and management of local waterways and catchments. It achieves this by engaging with communities and providing education, methods and tools that enable local groups to take action.

With the support of a Wai Care Coordinator, groups undertake a range of activities such as water quality monitoring, stream restoration through native planting and weed control, education and advocacy. These all combine to promote the enhancement of the health of local waterways and catchments. Many other individuals, organisations and groups are also supported by Wai Care, through school programmes or one-off community events.

Water health and water quality monitoring techniques, educational materials and tools generated through the programme are made available to local Wai Care groups. This data as well as resources are also accessed by other Council departments, agencies such as Landcare Research, universities and the Department of Conservation.

Each group that Wai Care works with is offered a programme that is specifically tailored to their needs and interests. Programmes are developed over time to cater for changing priorities. Groups may come to Wai Care with different information needs, for example some groups may have and educational focus and be seeking basic water quality information for school studies. Others want more technically and scientifically rigorous information to use for making submissions and other advocacy work. The programme is dynamic and constantly evolving as those involved in it develop new methods, resources and ideas.

Wai Care is involved in a range of activities that contribute to positive environmental outcomes. The programme has a catchment wide focus, often starting with freshwater systems but looking at sustainability issues in a broader context than simply streams. The strength of the programme is in its flexibility around the delivery that is not solely focussed around water quality monitoring, although this is where many groups begin their Wai Care journey. Groups often start off simply monitoring stream water quality, as this is tangible and a good way to get a group established. Over time, many groups want to use their knowledge, data and enthusiasm to make direct and tangible improvements to 'their' waterway. Many begin to supplement their data gathering with on the ground actions like removing rubbish from their stream or planting out riparian margins. Wai Care Co-ordinators take an active role in helping groups to plan, implement and monitor actions.

Sustainable Catchments Programme

The Auckland Council Sustainable Catchments Programme provides an integrated planning and implementation framework to address the long-term health of priority waterways in the Auckland region. It is guided by science, and relies heavily on community engagement processes to understand community values and objectives, raise awareness of the issues and get the 'on the ground' works such as planting happening – hence its byline "Weaving science and community into action". The Sustainable Catchments Programme was established around four years ago working with private landowners in the rural catchments of Mahurangi, Whangateau and Kaipara building upon eight years work on the

Wai Care stream education and monitoring in action: Waitakere Stream, Cascades Park 2010

"The diversity of programmes highlights there is no single right way to address water quality issues through community engagement programmes."

Mahurangi Action Plan. The programme is currently expanding into four additional urban catchments.

The Sustainable Catchments Programme approaches rural and urban catchments differently. To date it has primarily been involved in rural catchments. In a rural context, those people identified as having direct affects on harbour health are considered primary stakeholders and engagement techniques for these groups include on farm property support, education through harbour health workshops, and access to funding for plants or fencing materials. Secondary stakeholders are those who may not have a direct impact on stream health but can support and influence primary stakeholders. Secondary stakeholder engagement activities include support for community events such as A & P shows, community forums, support for education and arts projects, and planting days on private land.

Tools used across both sets of stakeholders are communications and environmental monitoring. Communications are used to inform on actions and report on results, and water quality monitoring supported by Wai Care increases understanding of the local environment and sets out important baseline data to guide future action and evaluate impacts and progress.

The Sustainable Catchments Programme follows a clear process to build understanding of the catchment and develop critical partnerships and relationships with stakeholders;

- Build partnerships/relationships (identify and work with existing or potential community leaders as well as established groups / individuals who can assist with projects)
- Describe/understand the catchment (including the science of the catchment e.g. current status of harbour health, stakeholder values and objectives, socio-economic condition)
- Set goals and identify priority solutions (the information gathered is used to set goals specific to each catchment and identify the most appropriate solutions to achieve these goals)
- Design an implementation programme (using various tools such as workshops, forums, integration with other community or environmental programmes etc)
- Measure progress and adjust plan

Landowners discuss their farm plans with council staff, December 2011

A key foundation of the programme is long term thinking and as such significant results are not likely to be seen in the short term. Even so, the many achievements to date due to landowner and public work include over 1000ha of land being protected, approximately 200,000 plants in the ground, around 100km of fencing to protect waterways, and multiple planting and education events. A highlight of the education activities has been the Kaipara Harbour 'snapper run' where landowners were taken out on an oyster barge with NIWA scientist Dr Mark Morrison to see juvenile fish amongst the seagrass beds to highlight the importance of the harbour as a fish nursery.

By working with primary stakeholders and providing specific engagement to support increased use of best practice landowners act as the best advocates, leading by example in their local areas. Examples of key secondary stakeholder groups taking leadership include the development of the Mahurangi Action Plan (10 year collaborative action plan for the Mahurangi) that takes into account community aspirations and values beyond water quality. The programme's support of creative education activities include assistance with at water-themed theatre production, educational messages for songs and videos composed and created by secondary schools students with titles such as "From the river to the sea", as well as a children's book written by a Mahurangi College student "The great cockle mystery".

The programme is now developing a further four new urban catchment projects Projects will build on the existing council work and complement local community action wherever possible.

Stormwater Streamside Restoration Projects

Urban neighbourhood Streamside Restoration Projects have been carried out to achieve stream enhancement outcomes on Auckland's North Shore since early 2008. Pilot projects were initiated on the Eskdale Stream at the Pine Ridge Apartments, Birkenhead in January 2008 and the Taiaotea Stream at Bayside in January 2009. There have been several subsequent projects including Little Shoal Bay, Domain Road, Soldiers Bay, Mid-Eskdale, and Kauri Glen. Overarching features of each of the projects include the use of an integrated planning approach and non-traditional community engagement methods. They are all based around urban streams on the North Shore, primarily on private properties, presenting unique challenges and also opportunities for community engagement. Some projects also include areas surrounding public land.

In the current project area, approximately 70% of streams are on private land. As such, empowering community involvement is not only essential but is considered to be key component in fostering a sense of shared ownership. There is a strong recognition that projects founded on traditional passive communication and education approaches (i.e. provision of information) do not necessarily result in increases in community engagement. Instead the projects have aimed to use active community engagement strategies and partnership programmes that involve communities feeling a sense of ownership in their local restoration activities, that also address

Community planting day, Ridgewood Reserve, 2012

environmental and sustainability issues. As well as striving to achieve a holistic approach to engagement, the projects are supported by data from a number of key environmental and social research findings.

The communications for these projects were originally founded on a Community-Based Social Marketing (CBSM) approach, popularised by Canadian environmental psychologist Doug McKenzie-Mohr. CBSM seeks to initiate change in the overall behaviour of communities in reducing detrimental environmental impact by using techniques such as focus groups and surveys to identify barriers and benefits of particular environmental initiatives. Over time project evaluation and consultation has resulted in changes in approach, recognising that a suite of communication touch-points and techniques are required to empower diverse communities.

Council has used a community facilitator, local community restoration groups, and contractors to work on the ground supporting landowners. Specific engagement and facilitation techniques have included: door knocking, use of social media (such as facebook), private property restoration consultancy visits, educational workshops, provision of free plants, organised community weeding and planting events on public land often with a social focus such as a BBQ, as well as newsletter drops and promotional flyers and posters.

A consistent outcome of the programme is that most owners of private properties with streams are keen to participate, the main barrier being lack of knowledge of where to start and how to go about it. Social data reports gathered from pilot projects Pine Ridge and Bayside show benefits go well beyond environmental restoration and include social networking, a sense of genuine partnership, and community cohesion with neighbours helping neighbours. The number of people getting involved in these stream restoration programmes indicating that residents are strongly interested in environmental issues and are prepared to take action to improve and protect their environment.

> "A key feature of programmes is that they are flexible and have the ability to respond to new challenges and opportunities as they arise."

Conclusion

The ongoing development of the urban and rural environment, and issues such as flooding and erosion, has impacted greatly on the state of streams and harbours in the Auckland Region. Active techniques to empower public engagement in addressing water quality can provide diverse benefits – from community connectedness to the natural environment to improved stormwater performance. This article presents four examples of programmes in which Auckland Council partners with communities to achieve water quality improvement. Although these programmes differ in the way they are tailored individually to particular communities and localities, all recognise the need for an engagement process which goes beyond just the provision of information. These projects aim to limit barriers to participation and to provide experiences that create emotional connections between people and the environment. ■

FrankPKS Delivers a Vote of Faith in Christchurch

The demand for state-of-the-art, super-resilient infrastructure to underpin the rebuild of Christchurch received a major boost with the commissioning of a multi-million dollar plastic pipe manufacturing plant in Bromley on October 24.

Christchurch company FrankPKS New Zealand is in the final stages of preparing the $3million-plus production line, which will equip it to more than double production of its specialised high-density polyethylene (HDPE) pipes, as well as produce a significantly expanded array of pipe sizes, up to four metres diameter.

Its general manager, Bryan Wilson, says that will position it to supply critical materials for the Christchurch rebuild, as well as service growing demand from local government and heavy industry around New Zealand.

It is a landmark achievement for the business – majority owned by local shareholders and drawing on world-leading technology shared with a German partner – which like many in Christchurch was left with ruined premises and an uncertain future after the February, 2011 earthquake.

"It is a landmark achievement for the business – majority owned by local shareholders and drawing on world-leading technology shared with a German partner – which like many in Christchurch was left with ruined premises and an uncertain future after the February, 2011 earthquake."

Mr Wilson says the project is a major vote of faith in the future of Christchurch, and particularly the city's east. He said there was never any question about its determination to resume production as quickly as possible, and within 60 days it had moved to a new factory a short distance across the Bromley industrial area, re-installing its existing production line and pushing ahead with planning for the new line.

Above left – The pipe manufacturing plant in Bromley, Above and Top – Inside the state-of-the-art pipe manufacturing plant

In recent months, the new plant had been shipped to New Zealand after initial construction in Germany, with a team of technicians also travelling here to assist the Christchurch company's staff in installation and the complex commissioning project.

Mr Wilson said that while smaller-diameter plastic pipe was commonplace in New Zealand industry, FrankPKS' specialisation in large-diameter products (from 0.5 to 4m) marked it out and provided a valuable alternative to traditional concrete or cast-iron for uses such as sewage mains, wastewater treatment plants, ocean outfalls and heavy industrial applications.

He acknowledged that HDPE pipes were a relatively unknown quantity to some engineers and infrastructure managers in New Zealand, but were widely used across America, Europe and Asia. Their capacity to cope with the most punishing environments and forces, including strong earthquakes, meant they were widely used in seismically active countries such as Chile, Japan and Italy; they were also increasingly being sought out for Christchurch's multi-billion dollar infrastructure rebuild. In areas where they were already in place before the earthquakes they had come through unscathed

The manufacturing technology used by FrankPKS at its Bromley plant was unique in the southern hemisphere, and the company had invested heavily in importing expertise and supporting standards specifications, to help the wider industry understand, scrutinise and test the suitability of the processes and products, Mr Wilson said.

The new plant was officially commissioned at a ceremony at FrankPKS in Francella Street, Bromley on Wednesday, October 24 2012. ■

"The manufacturing technology used by FrankPKS at its Bromley plant was unique in the southern hemisphere, and the company had invested heavily in importing expertise and supporting standards specifications, to help the wider industry understand, scrutinise and test the suitability of the processes and products..."

ACUFLO®

NZ OWNED & NZ MARKET COMMITTED
PROVEN PRODUCTS & PERFORMANCE

MANIFOLDS

New Zealand 20 year industry favourite.
Meter, Backflow, Flow Control, Strainer.
Full range. DR Brass or Composite Materials

WATER METERS

Full range of models and sizes.
OIML R49 and ISO 4064 listed
Sensus - Maddalena - Acuflo models

BOXES

Full range of sizes. Superior polypropylene material. Customised lids, boxes and bases.

BACKFLOW

Full range of models and sizes.
AS/NZ 2845 and ICNZ listed.
Febco - Wilkins - Acuflo models

PERFORMANCE TESTED

All Acuflo products are performance tested against pressure loss and accuracy.

NEW ZEALAND MADE

ACUFLO INDUSTRIES LTD

31 Reeve Street, Levin, New Zealand | Phone 06 368 4996 | Fax 06 367 9201
PO Box 660 | sales@acuflo.co.nz | www.acuflo.co.nz

ISO 9001 CERTIFIED GCS

Water New Zealand Conferences & Events

***Water New Zealand* Backflow Conference 2013**
18 – 19 April 2013
Auckland, New Zealand
More information will be available soon.

***Water New Zealand* 8th South Pacific Stormwater Conference 2013**
8 – 10 May 2013
Auckland, New Zealand

***Water New Zealand* Annual Conference & Expo 2013**
16 – 18 October 2013
Hamilton, New Zealand
More information will be available in early 2013.

For more information on *Water New Zealand* conferences visit www.waternz.org.nz/events

Other Conferences

The 4th IWA Asia-Pacific YWP 2012 Conference
7 – 10 December 2012
Tokyo, Japan
For more information visit
www.ce.t.kanazawa-u.ac.jp/~honda/apywp2012

OZWATER'13
7 – 9 May 2013
Perth, Australia
For more information visit www.ozwater.org

Become a Member of *Water New Zealand* Today

For a membership application form please contact:

Water New Zealand
P: +64 4 472 8925
E: enquiries@waternz.org.nz

Changed jobs or details? Let us know. Moving jobs doesn't mean you have to resign! Simply let us know your new employer contact details, and your membership will continue uninterrupted.

Advertisers Index

Classifieds

FLYGT
a xylem brand

In the tradition of groundbreaking innovations comes...

Flygt Experior™

Welcome to a new era in wastewater pumping. Where engineering excellence and a pioneering spirit combine with an unmatched understanding of your needs. The result is Flygt Experior, a uniquely holistic experience that combines state-of-the-art hydraulics, motors, and controls.

Today, Flygt Experior combines N-technology hydraulics and its adaptive functionality, premium efficiency motors and SmartRun – the all-new intelligent control. Flygt Experior comes from years of listening to you and applying our knowledge and expertise, to develop the most reliable and energy-efficient wastewater pumping. It is therefore the ultimate in our commitment to you.

Flygt Experior™. Inspired by you. Engineered by us.

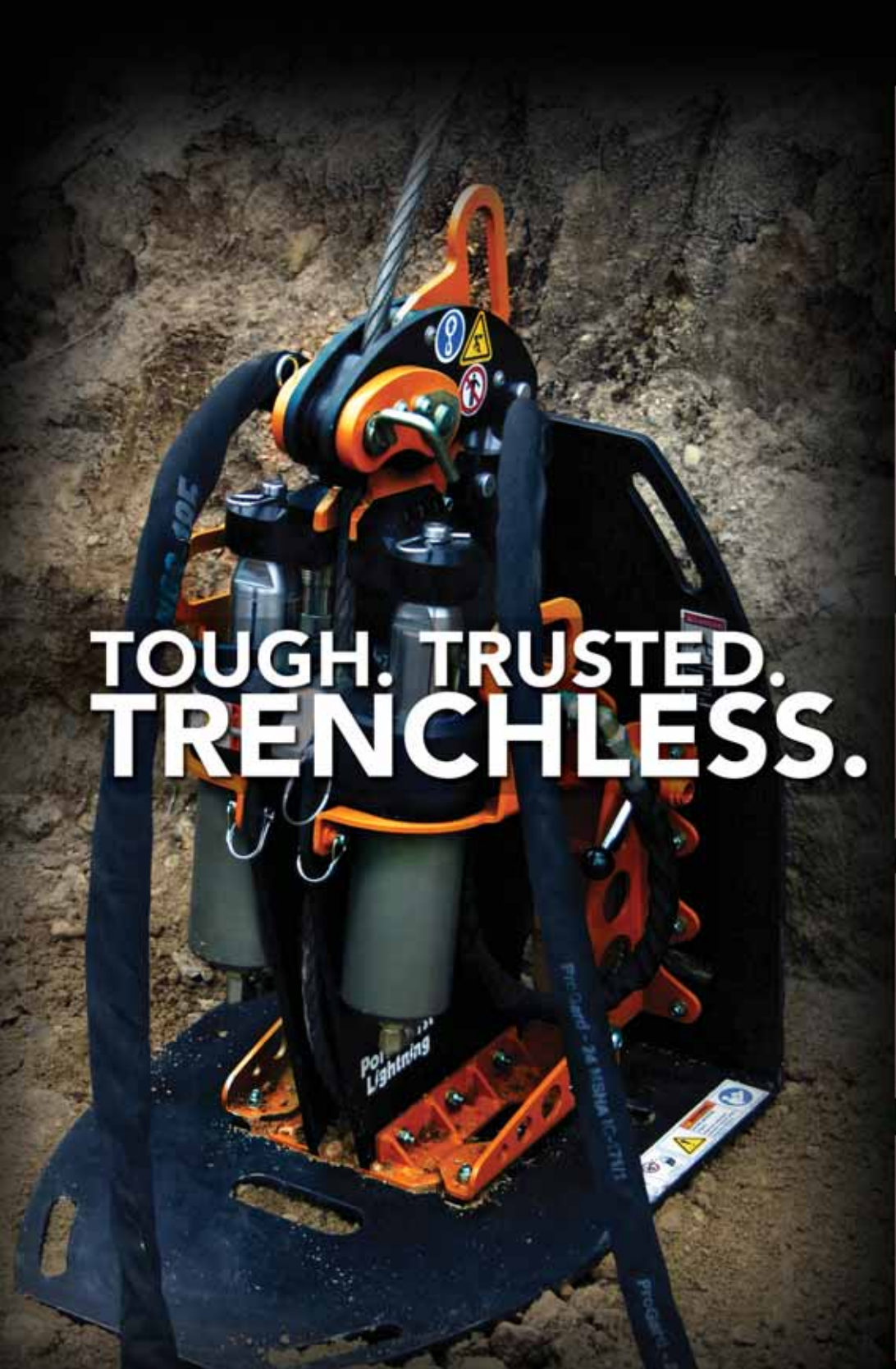
Tel 0800 33 19 14

flygt.com/FlygtExperior

Flygt is a brand of Xylem, whose 12,000 employees are dedicated to addressing the most complex issues in the global water market. Let's solve water.

xylem
Let's Solve Water

TOUGH. TRUSTED. TRENCHLESS.



STATIC PIPE BURSTING

FROM 38 TO 175 TON MACHINES

PNEUMATIC PIPE BURSTING

SYSTEMS FOR BURSTING PIPE UP TO 36"

PIPE RAMMING/HDD ASSIST

INSTALL STEEL CASINGS, RESCUE STUCK HDD BORES AND MORE!

PIERCING TOOLS

24 MODELS TO FIT YOUR CONDITIONS

HYDROGUIDE® WINCHES

FOR BURSTING AND LINING APPLICATIONS

PORTABURST® LATERAL PIPE BURSTING SYSTEM

HammerHead, a leader in unique answers for underground utility installation and replacement since 1989. Genuine HammerHead Trenchless equipment is available only at your authorized dealer.

Ditch Witch NEW ZEALAND

24K Allright Place, Mt Wellington, Auckland
09 570 1002 or 0800 DWNZLTD
www.ditchwitchnz.com

HAMMERHEAD TRENCHLESS EQUIPMENT

MOLING | RAMMING | BURSTING | HDD ASSIST | WINCHES