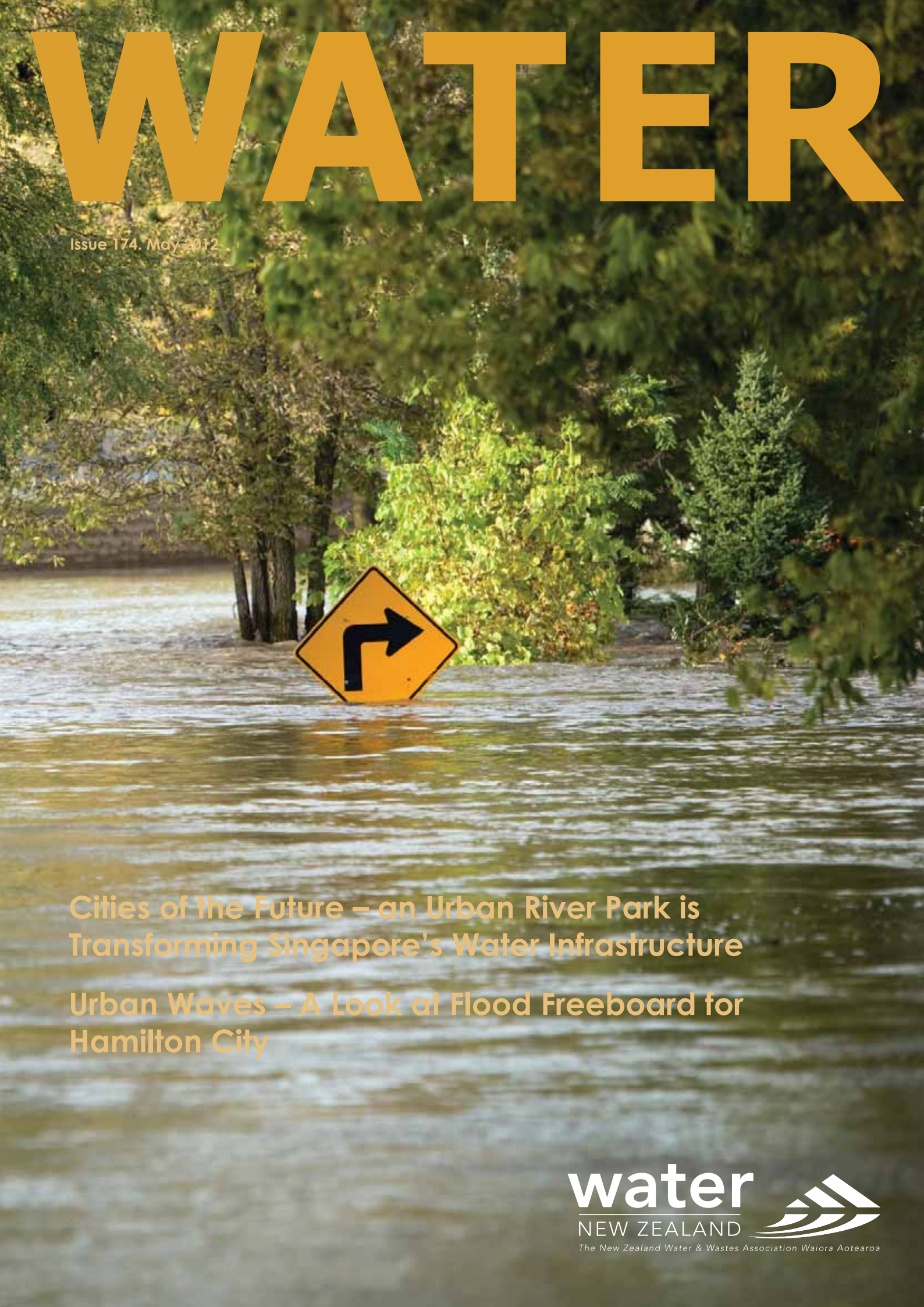
WATER

Issue 174. May 2012



Cities of the Future – an Urban River Park is Transforming Singapore's Water Infrastructure

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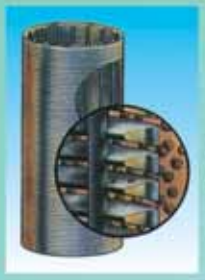

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The next issue of *WATER* will be published in July 2012.

On the Cover

Water New Zealand News

Features and Articles

Cover photo: iStock.com

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.

Clive Rundle

President's Column

It is that time of year when we will soon be calling for nominations for election to the *Water New Zealand* Board. This is an important role within the organisation, especially so during current times of change. I encourage you to consider standing for the Board or, alternatively, encouraging and supporting others whom you consider have the energy and experience to contribute at a governance level. It is both a challenging and rewarding experience.

"I encourage you to consider standing for the Board or, alternatively, encouraging and supporting others whom you consider have the energy and experience to contribute at a governance level."

My term as President will end at this year's AGM held during September's annual conference. The board chooses one of its members as President-Elect in advance so that they can prepare themselves for the role and I am pleased to announce that your new president will be Steve Couper. On behalf of you all I congratulate Steve on his election. Steve has a passion for the water industry which I know will translate into effective leadership for *Water New Zealand* during his term of office.

You'll be pleased to know that planning is well in hand for our annual conference in Rotorua and it is shaping up to be another successful event. The Christchurch Convention Centre, which is where the conference would normally have been held this year, is out of action and likely to be so at least until 2015 or even 2016.

I am often asked why we have traditionally alternated between Rotorua and Christchurch for our annual conference. The simple reason is that there have been no other venues that are large enough to accommodate us. It may surprise you that even in Auckland, where we would love to hold an event, there is no venue that will accommodate both the conference sessions and the trade expo which is vital to the financial viability of the conference. The fact that our largest city cannot accommodate us by a long chalk is interesting given the current debate about whether government should be negotiating with SKYCITY for the development of a larger venue.

That said, we have taken steps to allow for a conference at the Claudelands Event Centre in Hamilton in 2013. The alternative is to return to Rotorua for a third successive year. In order to assist us to make a decision, registration forms for the 2012 conference will ask registrants to indicate their preference between Rotorua or Claudelands for 2013. Please take the time to let us know your thoughts.

The conference is a time when we celebrate our best and brightest and toast their success at the conference dinner. This is fitting as it is the only time the whole of the water 'family' gathers together. Nominations for the suite of Association awards will be called over the next month or so and I encourage you all to nominate suitable candidates.

"The conference is a time when we celebrate our best and brightest and toast their success at the conference dinner. This is fitting as it is the only time the whole of the water 'family' gathers together."

Lastly, I want to share with you a matter which has been on my mind recently. The tragic events in Christchurch have highlighted the importance of professional engineering judgement and the criticality of our industry to society. The Royal Commission process has brought the engineering profession into the spotlight and competency frameworks seem likely to be the subject of some scrutiny, particularly in the structural disciplines. Although I believe the professionalism of those in the water industry has only been enhanced by our response to the challenges post-earthquake, I do wonder if it is time for us to examine whether a formal professional competency framework tuned to the needs of our industry is required. Is it time for the water industry to start thinking about aligning with organisations like CIWEM in the UK which has a framework for water and environmental professionals (both engineers and scientists) to reach chartered status? Or perhaps we develop specific competencies within IPENZ's current CPEng system? It is food for thought. ■

Clive Rundle
President, Water New Zealand

new members

Water New Zealand welcomes the following new members:

PAULA BROWN
MARK PEARSON
PETER MCLENNAN
DAVID CARSHALTON
CHRIS LAIDLOW
DESMOND SCRIMGEOUR
JOANNA SAYWELL
GRAHAM WEBB
JAVIER CALVAR
TONY CONNELL
BARRY NITSCHKE
BRYAN FRASER
LEONARD WHITTAKER
RUFINO GUINTO
SARAH LOTHMAN
DIRK NIEUWKERK
DEREK LACHUT
CHRIS ANDERSON
KEVIN BOLGER
GRAEME SALMON
CHRIS PEPPER
CLIVE WELLING
MARTIN DASLER
TONY CAIN
TOINE VAN DE POL
NEVILLE LAVERACK
KEITH WILLIAMS

Murray Gibb

Peak Water?

The concept of peak oil is well understood. It is the time when the maximum rate of oil extraction is reached, after which production enters terminal decline. A geoscientist, Marion King Hubbert, developed the concept in 1956 and predicted peak oil production in the United States to be between 1966 and 1970. His prediction was validated when peak production was reached there in 1970.

His forecasts have proven to be accurate for oil production worldwide, and it is generally reckoned that globally we are at, or over the next decade or so, will reach peak oil.

Could this concept be usefully applied to water – a renewable resource? Peter Gleick and Meena Palaniappan argue that it could, in a paper published in the *Proceedings of the National Academy of Science*[1].

As they point out humanity faces serious water challenges.

"Globally it is estimated that we are now using over 50% of all renewable and accessible freshwater flows. Freshwater underpins human life, agricultural production, economic activity and ecosystems functions. As populations and economies grow, new constraints on water resources are appearing raising questions about the limits of water availability."

Is there enough water to go around as demand side pressures on the resource increase? Gleick and Palaniappan suggest that the peak resource concept could help hydrologists, water planners and managers answer this question and better manage the resource.

They point to the differences between renewable and non-renewable resources. The former are flow or rate limited, the latter are stock limited. When the last barrel of oil is extracted the stock will be exhausted. Water exhibits renewable and non – renewable characteristics. It is of course largely the former, but when a fossil aquifer is drained, that stock of water is transferred into the oceans and is effectively no longer available.

"When withdrawals are not replaced on a timescale of interest to society, eventually that stock becomes depleted. The water itself remains in the hydrological cycle, in another stock or flow, but it is no longer available for use in the region originally found. When limits to water availability in a given region are reached, there are few possible options to meet additional needs."

They offer three definitions.

The first is peak renewable water. This is, "the fraction of total human use of water that comes from renewable flows of rainfall, rivers, streams and groundwater basins that are recharged over relatively short timeframes." The ultimate abstraction limit is the complete renewable flow, but practically the limit will be substantially below that level because of consequential environmental damage.

The second is peak nonrenewable water. Some groundwater aquifers have recharge rates that are so slow that once drained, they are no longer useful sources. Once drained, others may lose the ability to recharge due to ground compaction. Continued production of water beyond minimal recharge rates is not possible, hence the placement of these sources under the nonrenewable category.

The last is peak ecological water. Plotting rates of water abstraction against the total societal and ecological value of water produces a bell shaped curve. Beyond a peak value there is a steep drop off in the value of any further abstraction to the community and consequential environmental damage. The experiment with cotton growing using Aral Sea water is a case in point.

The authors suggest that the United States may have passed the point of peak water in about 1970 at the same time as it did for oil.

"The concept of peak water does not mean we will run out of water. Water is a renewable resource and is not consumed in a global sense. Hence water uses within renewable peak limits can continue indefinitely. But not all water is renewable, indeed some water uses are nonrenewable and unsustainable. Groundwater use beyond normal recharge rates follows a peak oil type curve…"

"Such peak nonrenewable water problems are increasingly evident in major groundwater basins with critical levels of overdraft, such as the Ogallala in the mid-west of the USA and California's Central Valley … the North China Plains, and in numerous states in India such as Andhra Pradesh, Rajistan and Tamil Nadu."

"Peak ecological water refers to the point after which the cost of disruptions that occur in the ecological services that water provides exceeds the value provided by additional increments of water use by humans. Defined this way, many regions of the world have already passed peak ecological water."

"The bad news is that we are increasingly reaching peak water limits. The good news is that recognising and understanding these limits can stimulate innovations and behaviours that can reduce water use and increase the productivity of water, shifting water policy to a more sustainable future."

The concept has merit. ■

Footnotes

[1]Gleick, P.H. and Palaniappan, M. "Peak water limits to freshwater withdrawl and use": Proceedings of the National Academy of Sciences of the United States; May 2010. Accessed 12 March 2012. http://www.pnas.org/content/early/2010/05/20/1004812107.abstract

Murray Gibb
Chief Executive, Water New Zealand

Water New Zealand's Annual Conference & Expo 2012

Awards 2012

A number of awards are available at each Annual Conference. In 2012 these are:

- Young Water Professional of the Year Award (sponsor to be advised)
- Opus International Trainee of the Year
- Orica Chemnet Operations Award
- Ronald Hicks Memorial Award
- Hynds Paper of the Year: Gold, Silver, Bronze
- AWT Poster Awards: Best Poster & 2 x Highly Commended Technical Committee Certificates
- Exhibition Awards: Best Expo Stand and 2 x Highly Commended

Registrations

Registrations will open via www.waternz.org.nz on Wednesday 6 June. An email and mailout flyer will be sent to *Water New Zealand* members and past attendees once registrations have opened.

Conference Themes

The 2012 Conference will have a core theme of ***'Water – Challenges & Opportunities'***.

The conference will have three primary streams plus full modelling and operation streams. Also included are an IWA Science, ASTT Trenchless Technology and SWANS stream.

Exhibition Sites

The Annual Conference Exhibition continues to be the largest trade exhibition for the sector with over 170 sites.

Poster Presentations – Submit Summaries Now

Poster presentations are always a popular component of the Annual Conference.

Poster summaries need to be submitted by Monday 30 July. Please visit www.waternz.org.nz for more information and to submit your poster summary online.

Key Dates for Your Diary

6 June	**Registrations open**
3 August	**Earlybird registrations close**

Key Diary Dates for Presenters

25 May	**Authors advised of selection**
30 July	**Poster summaries due**
2 August	**Final papers due**
14 September	**Powerpoint presentations due**

The Stormwater Conference Report will be included in the July issue of *WATER*.

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Oxfam Appeal to Improve Water Supply

It's a dilemma no mother should have to face – risk her children's health using dirty water or go without. Papua New Guinea Highlanders like Bebi Samuel, 29, face this dilemma daily.

In the wet season, about half the year, Bebi and other villagers share a nearby spring to gather their water. But often it's not much more than a trickle and it takes hours to fill up water cans. Because of this, the water is saved for cooking and drinking, and the family goes without clean clothes, bedding and bodies. Washing themselves is a luxury.

In the dry season, water becomes even more precious. When the trickle at the spring becomes too little to support the 2500 people in the village, Bebi and others trek down to the Waghi River to collect water.

> "After walking just 30 minutes carrying heavy water jerry cans, I feel empathy for the thousands of women across the Pacific who have to walk for hours up steep terrain to collect water. It is a special feeling to know we can help them experience the gift of safe water close to their homes."

"We go with all our kids and we come back with wet clothes, food from the gardens and the kids. We also have to fetch water so our return trip takes about eight to ten hours and it's a heavy load for us," says Bebi.

She can carry only enough for two or three days in one trip, so a few days later the whole hike has to be repeated. All this for water polluted by communities upstream who dump household waste and defecate in the water.

The lack of access to clean, safe water has implications beyond immediate health and sanitation issues, which often sees villagers missing work and school due to diarrhoea and other waterborne illnesses. Bebi's school-age daughter spends time collecting water to wash instead of attending school or doing homework, and Bebi herself has less time to spend in the family's food producing garden.

Oxfam works with villages like Bebi's across the Highlands of Papua New Guinea to build rainwater catchment and gravity-fed systems, ensuring inhabitants all have access to clean, safe water. People in the village work with Oxfam to build the systems, meaning they have the knowledge to fix it if something goes wrong in the future. The communities also raise 10 per cent of the cost of the project, giving them a stake in the project's success.

In Bebi's village, improvements have already been seen. Toilets have been built and Oxfam specialists in health and hygiene have conducted training sessions for the community. This has had a remarkable effect and waterborne illnesses are on the decline.

Inspired by Bebi's story, and those of many women like her across the Pacific, Oxfam New Zealand's Executive Director Barry Coates was joined by staff and supporters recently to recreate part of her journey by carrying heavy loads of water, vegetables and bedding up Queen Street in Auckland.

"For Kiwis the gift of safe, drinking water is instantaneous, literally available at the turn of a tap," says Coates.

"We tend to take it for granted. After walking just 30 minutes carrying heavy water jerry cans, I feel empathy for the thousands of women across the Pacific who have to walk for hours up steep terrain to collect water. It is a special feeling to know we can help them experience the gift of safe water close to their homes."

Oxfam is raising money to support its work with communities like Bebi's across the Pacific and Southeast Asia. Its Water Appeal aims to raise $250,000. To watch a video about Bebi and to donate, please go to www.oxfam.org.nz/waterappeal. ■

WEFTEC 2012 is Coming – Jazz It Up in New Orleans

Garry Macdonald – Water New Zealand's Delegate to the Water Environment Federation

Clockwise from top left – New Orleans Morial Convention Centre, Warehouse Arts District near the Convention Centre, French Quarter at night

Registration and accommodation is now open for WEFTEC 2012, the Water Environment Federation's 85th Annual Technical Exhibition and Conference. This year's event will take place 29 September – 3 October, 2012 at the New Orleans Morial Convention Centre in New Orleans. This huge convention facility is right on the banks of the mighty Mississippi River, close to the French Quarter heart of one of the most exotic and historic cities in the USA. There is a wide range of reasonably-priced hotels within easy walking distance of the Morial Center, and there's a regular WEFTEC hotel-convention shuttle service as well.

If it's about water and wastewater, it will be at WEFTEC – as many previous Kiwi attendees will attest. As the largest annual water quality conference and exhibition in the world, WEFTEC continues to offer the best educational, business, and networking opportunities in the water profession today. This year's world-class technical program will feature 130 technical sessions with over 750 papers, 24 workshops, and six local facility tours. A wide range of topics and focus areas allow attendees to design their own, unique learning experience with the opportunity to mix visits to the exhibition floor with technical session attendance – while still allowing time for socialising and taking in the sights, sounds and smells unique to New Orleans.

The 2012 technical focus areas include:

- Collection Systems
- Disinfection and Public Health
- Facility Operations and Maintenance Future Insights
- Global Issues and Sustainability
- Government Affairs
- Industrial Issues and Treatment Technologies
- Research and Innovation
- Municipal Wastewater Treatment Process and Design
- Residuals and Bio-solids Management
- Stormwater Management
- Utility Management
- Water Reclamation and Reuse
- Watershed Resources Management and Sustainability.

> "If it's about water and wastewater, it will be at WEFTEC – as many previous Kiwi attendees will attest. As the largest annual water quality conference and exhibition in the world, WEFTEC continues to offer the best educational, business, and networking opportunities in the water profession today."

As a complement to the technical programme, WEFTEC's unrivalled exhibition will provide access to more than 900 exhibiting companies and their technical experts showing the latest developments, research, solutions, and cutting-edge technologies in the field.

Other conference highlights will include the Opening General Session and special preview of the exhibition floor on opening day, Monday, 1 October; the annual community outreach project, poster sessions, the design competition, the 25th annual Operations Challenge competition, and more. Details about the Opening General Session programme and keynote speaker will be announced at a later date.

Please visit www.weftec.org for registration information and the latest conference details, or contact Garry Macdonald on 09 300 9281 or email garry.macdonald@beca.com for any other information you need. ■

Alliance Announced Between InfraTrain, ESITO and EXITO

InfraTrain has joined forces with the Electricity Supply Industry Training Organisation (ESITO) and the Extractive Industries Industry Training Organisation (EXITO) to form the Infrastructure Services Alliance New Zealand (ISANZ) Group. The Group, which represents the construction, electricity supply and mining industries, will jointly provide leadership on training needs and promote skills development and training.

"The objective is to work together to improve the services we provide to both employers and trainees," says InfraTrain Chief Executive, Philip Aldridge.

The closer working relationship is expected to reduce costs, increase efficiency and enhance business results, including the provision of training across the wider national assets and infrastructure sectors.

EXITO Chief Executive, Kevin Walker, says they already have a very good relationship with ESITO and InfraTrain, and they look forward to working more effectively with them – and others – to reduce costs and barriers to their collective stakeholders.

A Memorandum of Understanding (MoU) has been signed to cement the agreement between the three Industry Training Organisations to work collaboratively and cooperatively on issues of mutual interest. The MoU includes provision for other organisations aligned to the infrastructure sector to join ISANZ.

An expected area of focus for the group in 2012 is ensuring there are enough people in training for the infrastructure sector to meet the short-term demands of the Christchurch rebuild and industry needs over the long-term.

"A Memorandum of Understanding (MoU) has been signed to cement the agreement between the three Industry Training Organisations to work collaboratively and cooperatively on issues of mutual interest."

"A common challenge our industries are facing right now is that we all have ageing workforces," says ESITO Chief Executive Tim Densem.

"With our combined expertise and resources I'm confident we can deliver strong leadership initiatives around this and other issues," says Tim. ■

About InfraTrain New Zealand, ESITO and EXITO

- InfraTrain New Zealand meets the needs for skills development in the broader construction and infrastructure sectors.
- ESITO covers training of workers in the electricity supply industry.
- EXITO is the industry training organisation for the mining, petrochemical, energy and resource recovery industries.

Collectively, the areas covered by these three ITOs make up the majority of the infrastructure sector.

An Update from the Modelling SIG

Brian Robinson, Chair, Modelling Special Interest Group

Introduction

As the incoming chair of the *Water New Zealand* Modelling Special Interest Group (SIG) committee, I thought it might be timely to give an update on what the committee is up to. We're lucky to have a very active, hard working and enthusiastic committee and we have a number of new members elected to the committee this year. I've been impressed to see the energy that the committee members bring to fulfil our role as best we are able. In this article I'll focus on just a couple of the key activities we're involved with at present.

Background

The SIG was formed 12 years ago and represents a mix of specialists and professionals involved with various aspects of hydraulic modelling in the water industry. This includes staff from local and regional authorities, scientists, academics, consultants, managers and suppliers, ranging from graduates to seasoned members.

"We're lucky to have a very active, hardworking and enthusiastic committee and we have a number of new members elected to the committee this year. I've been impressed to see the energy that the committee members bring to fulfil our role as best we are able."

The health of the group can be judged from the attendance of a wide range of people from the industry at events such as the modelling stream at the national conference and at a number of regional events held throughout the year. The numbers and enthusiasm of those attending attest to the relevance and effectiveness of the Modelling SIG.

The committee's terms of reference are many and varied, but some of our key functions are:

- Co-ordinating the Modelling Stream of the *Water New Zealand* Annual Conference
- Co-ordinating Regional Events
- Liaison with *Water New Zealand* and other SIGS as well as external organisations such as the IPENZ Rivers group, WaPUG, CIWEM and the Australian Hydraulic Modelling Association (AHMA)
- Developing, Updating and Monitoring of Guidelines
- Developing strategies to lift the profile of modellers in the water industry
- Liaising with Young Professionals
- Liaising with Research Organisations/Learning Institutions

Some of the key activities we're working on at the moment are discussed below.

Rainfall and Runoff Guidelines

Preamble

In response to member requests, the IPENZ Rivers Group and the *Water New Zealand* Modelling SIG have begun consultation with the industry on rainfall-runoff analysis, and the need for some national guidelines on the topic to ensure a more consistent approach across the country for determining the theoretical runoff as a result of rainfall. The initiative of developing a set of rainfall-runoff guidelines for New Zealand has been influenced by the knowledge that the Australian Rainfall and Runoff Guide (ARR) is currently undergoing an updating process with extensive research and development being undertaken. As this ARR document is in wide use around New Zealand, even without locally specific data being available, it is likely that a New Zealand-specific document of a similar nature would be even more widely used.

In October last year, an evening seminar was held in Auckland where the development of some national rainfall and runoff guidelines for New Zealand was discussed. The session was very well attended (with approximately 50 people from a wide spectrum of the industry) and there was some animated discussion with unanimous support of the development of such guidelines.

A subsequent session was held at the annual *Water New Zealand* conference (2011), where the topic was discussed in more detail which again generated a lot of interest and unanimous support. An open forum ensued where ideas were discussed as to the best way to advance this. Following on from these events, the SIG has formulated a plan to progress this project, and is currently seeking funding to enable the first stage of the project to be initiated.

Background

Runoff is a key input into a wide range of hydraulic modelling projects, but particularly for flood studies for rivers/streams and drainage networks. There is considerable uncertainty in application of an appropriate rainfall-runoff method to various regions within New Zealand. In some bigger centres, area-specific methods have been developed that are specified for use within these areas. In many smaller centres, there are no locally-specific guidelines and as a result, the methods applied in bigger centres are frequently used – sometimes erroneously.

With the methods that have been developed for certain regions in New Zealand, there is little consistency in results across these methods even with the same input data. This presents significant uncertainty, particularly for those regions where no locally specific data exist.

There has been widespread support for the initiative of collation of appropriate methods for use in New Zealand, with guidance on where and when each may be applicable. This would result in significant savings to the industry in;

- Consent applications where analyses are undertaken using approved methods, saving the need for extensive justification of analysis and/or peer review;
- No need for development of separate guidelines across all regions – one set of guidelines could apply nationally;
- Consistency in results across different methods would lend greater credibility to analyses, resulting in higher confidence in outputs.

The Vision

There is a desire within the New Zealand technical community to see the development of a comprehensive guideline, similar to the updated ARR, for use nationally around New Zealand. This would be a significant undertaking, but would ultimately deliver value to practitioners nationwide.

It is recognised that from the current position of there being no nationally applicable or recognised rainfall-runoff guideline, getting to the position of having a definitive document for the country is a large task that needs to be split into smaller sub-tasks. It is apparent that there is broad technical community support for the proposed initiative of development of rainfall-runoff guidelines for New Zealand.

The first step in this process has been identified as an assessment and a collation of all that is currently known or frequently applied in New Zealand. Some accuracy testing of various methods will be required to determine the most applicable methods for use within New Zealand, based on actual data rather than on overseas performance. Reference to other documents and guidelines will ensure minimal re-work (e.g. use ARR where applicable, together with other international guidelines and best practice).

In order to guide the process, it is proposed that a Steering Group Committee (SGC) is set up with representation from a wide range of interested parties. The role of this committee would be to guide the process towards the ultimate objective of a nationally applicable rainfall and runoff guideline. At this stage no formal Steering Group Committee has been established, although widespread interest has been expressed from a number of parties.

Stage 1 Overview

It is envisaged that the first stage of the project would essentially be a review of the methods and guidelines that are currently in use in New Zealand, including liaison with interested parties such as regional, district and city councils, crown research institutes (such as NIWA), consultants and industry, followed by dissemination of findings and consultation with the technical community. A business case has been developed and funding for this first stage is currently being sought.

Planning for Modelling Stream at Water New Zealand Annual Conference

Planning is currently underway for the modelling stream of the annual *Water New Zealand* conference to be held in Rotorua in September, and it promises to be a good one. We're excited to announce that we will have both the chair and vice chair of WaPUG (formerly the Wastewater Planning User Group, but now CIWEM's Urban Drainage Group in the UK) attending this year's conference.

"The SIG was formed 12 years ago and represents a mix of specialists and professionals involved with various aspects of hydraulic modelling in the water industry. This includes staff from local and regional authorities, scientists, academics, consultants, managers and suppliers, ranging from graduates to seasoned members."

WaPUG has a long history of promoting best practice in the field of urban drainage. Formed in 1984, it organises technical conferences and specialist workshops that attract delegates from all parts of the urban drainage community and at all levels, from trainees to senior managers. WaPUG fulfils a similar function to the *Water New Zealand* Modelling SIG, with some of their key activities being:

- Promoting best practice in sustainable planning, design and management of urban drainage systems
- Influencing Government policy on urban flooding and pollution risk
- Providing a forum for discussion and debate on leading issues
- Enabling members to socialise, develop their professional skills and share expertise
- Promoting technical excellence through Codes of Practice and technical guides

In addition to giving a keynote speech for the modelling stream, current plans will see them present a paper about recent developments in the modelling industry in the UK as well as participate in a forum discussion, and facilitate some interactive workshop sessions.

We see this as a fantastic opportunity to strengthen links and learn from our UK colleagues who are widely considered to be world leaders in drainage modelling, having been in existence as an organisation for almost 30 years and having written the 'Code of Practice for the Hydraulic Modelling of Sewer System' which is often referred to by practitioners in New Zealand.

In addition to this, there will be a number of quality technical papers, some forum discussions and an opportunity to enjoy each other's company at the modelling dinner, so I would strongly encourage you to attend.

Regional Meetings

The committee places great emphasis on regional events as a means for sharing of knowledge, networking and learning from others experiences. Details are being finalised for a number of events including:

- a presentation about the development of the latest version of the 'High Intensity Rainfall Design Storms' (HIRDS) software in Christchurch
- a discussion about the synergies between the traffic modelling and water modelling industries in Auckland
- a site visit to learn about the New Zealand meteorological modelling process undertaken in Wellington

All promise to be interesting events, and offer a good opportunity for networking with other professionals in your area, so watch this space for details. We look forward to see you at one of these events. ■

Cawthron Appoints Professor Charles Eason as Chief Executive

Professor Charles Eason

Cawthron Board of Directors Chairman, Ian Kearney, today announced the appointment of Professor Charles Eason – a former senior manager with Landcare Research and a Professor at Lincoln University – as the new Chief Executive of Cawthron Institute.

In October 2011 outgoing Chief Executive, Gillian Wratt, announced her intention to step down from the role with effect from April 2012. An international executive search process has taken place over the summer with Professor Eason accepting the position this week. Professor Eason will take up the position at the beginning of June.

Professor Eason has a unique science sector background having held research and senior management positions in multi-national pharmaceutical companies and, in New Zealand in a Crown Research Institute, a university and a manufacturing business. He has led research groups in fields ranging from drug design to urban design, catchment management, conservation and product development. He has a PhD from the University of Surrey and has played a major role in the development of a number of new drugs for the treatment of cardiovascular diseases while working overseas. In New Zealand he worked for Landcare Research in different roles including being Regional Manager for Hamilton and Auckland. He returned to the "private sector" in 2006 as Research Director for Connovation Limited, an Auckland-based company producing new pest control tools that target introduced predators of native species. He was appointed a professor at Lincoln University in 2007 where he led research programmes and established the Centre for Wildlife Management and Conservation.

Professor Eason has a long standing connection with Cawthron, having been a member of the Trust Board from 1998 to 2003 and a member of the Board of Directors since 2003.

"Professor Eason will provide strong leadership of science research for Cawthron and assist Cawthron to continue to lead research and build credibility with national and international partners and stakeholders" said Ian Kearney. "His experience with the progression of core science through to practical solutions for use by industry reflects a key component of Cawthron's philosophy."

"His experience with the progression of core science through to practical solutions for use by industry reflects a key component of Cawthron's philosophy."

Professor Eason's achievements have been recognised by his peers and others. He has an extensive range of publications and has been a member of Advisory Groups for organisations such as the Animal Health Board, the New Zealand Environmental Protection Agency, the Tertiary Education Commission, and has been a participant in the Canberra-based Invasive Animals Cooperative Research Centre. He was awarded a NZST "silver medal" for his contribution to vertebrate pest control. In 1994 he was the winner of the New Zealand Society of Scientist Foundation for Research, Science & Technology Science Communicator award.

"It is a privilege to be able to lead such an important and historical institution, one with such a well-earned global reputation. Cawthron's excellent research, and its ability to use research to provide solutions to matters of importance to the environment and the use of our coastal and freshwater systems is important. Cawthron has a great platform of capable researchers, facilities and partnerships to enable it to play an exciting role in the development of New Zealand's seafood industry" Professor Eason said.

Daryl Wehner, Cawthron's Chief Financial Officer, will be acting Chief Executive when Gillian Wratt steps down at the end of March until Professor Eason takes up the new role in June. ■

International Conference on Health-Related Water Microbiology: Extreme Events and "The Rotorua Declaration"

Graham McBride, Marion Savill (New Zealand), Christobel Ferguson (Australia) and David Kay (UK)

A previous issue of this publication (issue 172, November 2011, at pages 51–55) contained a comprehensive summary of two parallel IWA conferences held in Rotorua in September of that year – the 16th International Symposium on Health-Related Water Microbiology and the 15th International Conference on Diffuse Pollution and Eutrophication. That issue particularly covered the proceedings of the latter conference.

"The meeting also featured a workshop on Extreme Events (the Christchurch and Spain earthquakes, Japanese tsunami, Haiti cholera outbreak, Hurricane Katrina, Queensland floods). It was concluded that the methods can be identified for assisting countries suffering infrastructure damage and HRWM as a group can assist in ensuring 'safe' drinking water."

The Health-Related Water Microbiology Symposium featured over 70 oral presentations and approximately 80 poster presentations on topics including viruses, microbial source tracking and technology, microbial risk assessment, catchment protection, recreational water and health, epidemiology of waterborne disease, novel ideas and emerging techniques, water and sanitation in developing countries, and a special session on climate change and natural disasters. The meeting also featured a workshop on Extreme Events (the Christchurch and Spain earthquakes, Japanese tsunami, Haiti cholera outbreak, Hurricane Katrina and Queensland floods). It was concluded that methods can be identified to assist countries with infrastructure damage and HRWM as a group can assist in ensuring 'safe' drinking water.

Prior to the IWA Mettings the opportunity was taken to hold a joint workshop on Catchment Microbial Modelling, a topic of increasing interest to both groups, organised by Graham McBride (New Zealand), Christobel Ferguson (Australia) and David Kay (UK). We are of the opinion that catchment microbial modelling needs to make significant advances to better inform public policy and

that it has been dragging along behind catchment nutrient modelling for too long.

The workshop was attended by about 60 delegates who heard seven invited presentations on many aspects of this topic all of which pointed to the need to make faster progress in this increasingly important area. So much so that a formal "Declaration" was prepared by the organisers and endorsed by the meeting. This has become known as "The Rotorua Declaration". It can be downloaded from the conference website (www.hrwm2011.org), and reads as follows:

Introduction

Catchment microbial modelling is a relatively new and developing field that has the potential to greatly enhance our knowledge and understanding of catchment processes and near-shore microbial dynamics.

Changing regulatory paradigms, primarily in North America and Europe, will require the estimation of microbial risk to inform Integrated Catchment Management and to protect water quality and human health.

Although sanitary profiling and water safety plans have been recommended as tools to meet these new needs; significant knowledge gaps remain and an additional challenge is to resource their implementation in developing nations as well as in the developed world. Emerging literature demonstrates that the use of microbial modelling represents an opportunity to enhance these approaches to water quality protection.

What's Needed

Further empirical and modelling investigations are needed which provide an integrated evidence-base for the policy community to address the following policy needs.

1. Real time prediction of environmental water quality at key water use sites such as: bathing; water abstraction; and shellfish harvesting areas.
2. Catchment models able to characterise the effects of best management practices (BMPs) deployed to limit and, where necessary, attenuate microbial flux to resource use sites, from:
   a. infrastructure point-source inputs; and
   b. diffuse rural and urban microbial sources.
3. Enhanced understanding of complex indicator-pathogen relationships through specific research on microbial ecology in key environmental compartments in both developing and developed nations.

These modelling systems must be directed to address specific questions, but remain capable of close integration between catchment and near-shore models. Some may also need to be integrated with source attribution and human health impact models. Key model features in this specific field typically include:

a. very short time-steps of minutes to hours reflecting the highly episodic nature of microbial flux; and
b. appropriate spatial scales, determined by model use requirements, from field-scale BMP implementation through to regional scale flux studies.

Specific parameterisation requirements include:

i. Microbial decay coefficients in water/soil/faecal matter/aquatic sediments and their principal drivers specifically to derive real-time decay kinetics that accommodate UV diurnality.
ii. Partitioning in each of these compartments but most importantly in the riverine and near-shore sediment systems which are key to understanding hydrograph and surf zone re-entrainment process dynamics.
iii. BMP effects and evidence-based design, with early focus on;
   - riparian fencing and buffer strips;
   - pond and wetland systems;
   - slurry and manure storage; and
   - disinfection of intermittent discharges (Combined Sewer Overflows & storm overflows).

Opportunity

We endorse efforts to promote and engage in the development and application of catchment microbial modelling and to address these knowledge gaps by promoting communication between regulators, operators, academia and all stakeholders engaged in Catchment Management to protect water quality and human health.

"The workshop was attended by about 60 delegates who heard seven invited presentations on many aspects of this topic all of which pointed to the need to make faster progress in this increasingly important area. So much so that a formal "Declaration" was prepared by the organisers and endorsed by the meeting. This has become known as "The Rotorua Declaration"."

The seven individual presentations are also available on the conference website. As well as addressing knowledge gaps and technical advances, they also addressed the two policy questions: How can models inform public policy development? and What do policy makers need?

These addresses are as follows:

- **Dr Christobel Ferguson (Australia)** – Introduction to Microbial Modelling of Catchments
- **Dr Sarah Dorner (Canada)** – Hydrologic Modelling of Pathogen Fate and Transport
- **Dr Jeremy Wilkinson (NZ/UK)** – Simulating E. coli Dynamics in the Motueka River, NZ
- **Dr David Roser (Australia)** – Case Study: Modelling Lake Parramatta Recreational Risks
- **Jeff Soller (USA)** – Use of catchment models to inform environmental policy: what information do policy-makers need?
- **Professor David Kay (UK)** – How can catchment models inform environmental policy what information do policy makers need – Europe?
- **Dr Richard Muirhead (NZ)** – Policy Implications ■


Hon Amy Adams

New Minister for the Environment

As most will know a new Minister for the Environment has been appointed following the resignation of Nick Smith. The next issue of Water will have a more in-depth article from the new Minister – Hon Amy Adams – but by way of background here are some biographical details.

Hon Adams was educated at Rangitoto College in Auckland and moved to Canterbury in 1988. She studied law at Canterbury University graduating with first class honours in 1992. Before being elected to Parliament she was a partner with Mortlock McCormack Law in Christchurch, specialising in commercial and property law.

The Minister is a previous member of the Canterbury District Law Society's Property Law committee, the New Zealand Law Society's Women's Consultative Group and the Institute of Directors. She lives in Canterbury with her husband Don and their two children on their 600 acre sheep and crop farm.

"As well as being Minister for the Environment Hon Adams is also Minister for Communications and Information Technology and Associate Minister for Canterbury Earthquake Recovery."

Hon Adams was first elected to Parliament for Selwyn in 2008 and served in her first term as Chairperson of both the Finance and Expenditure and Electoral Legislation select committees and also served as a member of the Justice and Electoral and Regulations Review Committees. She was re-elected in 2011 with a majority of 19,450 votes and was promoted to Cabinet.

As well as being Minister for the Environment Hon Adams is also Minister for Communications and Information Technology and Associate Minister for Canterbury Earthquake Recovery. She is ranked 19th in Cabinet and, as *Water* went to press, had yet to issue any media statements or make any speeches – water-related or otherwise – in her new portfolio.

Hon Adams was confirmed as Minister for the Environment on April 3. ■

New Zealand Engineering Excellence Awards 2012 Open

Initiated in 2005, the New Zealand Engineering Excellence Awards are the premier awards for New Zealand's engineering professionals. The awards are a fantastic way to showcase all the hard work and incredible innovation that goes on in the engineering profession.

There are awards for winners in three categories:

1. Awards Recognising People that recognise leadership, innovation, entrepreneurship and our young en-gineers' achievements
2. Project and Product Awards, which recognise achievement in various industry areas
3. Practice Awards which recognise excellence in environmental practice, community engagement and en-gineering for safety

There is also a Supreme Award for the best of the Project and Product winners.

For more information regarding Entry and Judging Criteria visit http://www.nzeeawards.org.nz/2012/awards-2012.cfm

Submissions close 5.00pm 1 July 2012. ■

Become a *Water New Zealand* Member Today

For a membership application form please contact:

Stephanie Berlips
P: +64 4 472 8925
E: stephanie.berlips@waternz.org.nz

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

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Contact: Stephanie Berlips
P: +64 4 472 8925, E: stephanie.berlips@waternz.org.nz

Details can be updated on line at www.waternz.org.nz/forms/changeofdetails/changeofdetails.html

NEXT ISSUE OF *WATER*

The next issue of *WATER* will be in mailboxes mid-July.

The topics for the July issue will be **Wastewater Design and Small Water Systems**.

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

The deadline to submit material is 11 June 2012.

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Involvement in Training Brings Rewards for Long Time Assessor and Moderator

Sean McHenry

Sean McHenry, a chartered civil engineer with 30 years' experience, says staff training is key for the water industry because it helps employers meet the technical skills requirements of contracts. Sean became involved with training in the industry a decade ago, when the National Certificate in Water Reticulation (Level 3) was rolled out.

"I was a manager for a water maintenance contractor in Wellington and I enrolled several staff members on the course," Sean says.

"Later because of my interest in training and my industry experience I was invited to become a registered workplace assessor for Water Industry Training."

Sean's civil engineering experience includes design and construction with local authorities, consultants and contractors. Twenty of his thirty years in the business have been in the water industry in New Zealand, Australia and the United Kingdom – experience that Annie Yeates, Water Industry Training manager, has found invaluable.

"Sean's expertise, passion and eye for detail, especially in the area of health and safety, have been of huge assistance to us over various reticulation projects," Annie says.

"He has been a good touchstone for us with regard to a new reticulation Level 3 delivery model we're developing. Sean has a very pragmatic and thorough approach to his work and we rely on industry experts like him who want to get involved and make a difference."

During the time he has worked with Water Industry Training Sean has held a number of vital roles.

"I've been a member of panels to review the reticulation Level 3 qualification and develop recognition of current competency resources and assessment materials," he says. "More recently I've been appointed internal moderator for the reticulation qualifications."

Sean is currently moderating and editing assessment materials for the new version of the National Certificate in Water Reticulation (Level 3), a job that includes checking for technical accuracy and health, safety and quality compliance. It has been a challenge he's enjoyed.

"One of the major challenges with the water reticulation qualifications is trying to make a single qualification appropriate for companies of all sizes and geographical locations," he says. "Their work might range from 24/7 reactive maintenance works to larger planned capital water main installations, whether publically or privately owned.

"Whilst Ministry of Health requirements are consistent across the nation, different local authorities have different standards and

"Sean's civil engineering experience includes design and construction with local authorities, consultants and contractors. Twenty of his thirty years in the business have been in the water industry in New Zealand, Australia and the United Kingdom – experience that Annie Yeates, Water Industry Training manager, has found invaluable."

specifications for their infrastructure including compliance issues in areas like traffic management, RMA consent conditions, working near or under trees, and road and footpath surface reinstatement standards.

"The recent qualification review and pathway structure developed in conjunction with InfraTrain New Zealand has mapped out a qualification structure which is more flexible and splits into different strands so that the qualification meets stakeholder requirements."

Sean says local authorities are now including the reticulation qualifications in their contractor selection processes.

"It benefits employers because they are meeting the 'technical skills' requirements for contracts. Trained employees are more likely to get the job done right first time without the unnecessary cost of rework.

"In my view, trainees also recognise the value of having qualifications, including that they improve job security, place them in a better position for promotion and, in some cases, increased remuneration."

He has found being involved in training in the industry over the last ten years a rewarding experience.

"My association with Water Industry Training enables me to meet with trainees, employers, consultants, contractors, local authorities and to work with a great support team in Wellington," he says.

"I continue to enjoy working in the water industry."

Annie says that the more Seans they have working with them, the better.

"Sean is passionate that our qualifications result in truly capable and competent graduates, just as we are. Those like Sean who have become involved with our work, whether as assessors or moderators, or as part of Industry Advisory Groups (IAG), enjoy the experience and find it rewarding.

"If anyone would like to get involved with future qualification reviews or would like to nominate their services to sit on an IAG please contact us."

To enrol or for more information about Water Industry Training's qualifications, call 0800 928 374 or visit www.waterit.ac.nz ■

About Water Industry Training

Water Industry Training is part of Agriculture ITO (AgITO). Water Industry Training provides leadership in education and training, develops national qualifications, maintains national standards and provides on-going support for their trainees and employers.

For more information about AgITO's qualifications, please visit www.waterit.ac.nz

Reform Proposals and Recent Water Quality Reports

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

Introduction

In this article we will provide an overview of two recent calls for reform – Local Government New Zealand's proposal for reform of the RMA plan and policy making processes and the Government's proposed reform of local government. This article will then move on to provide a brief update and comment on the progress of freshwater reform measures. We conclude with a summary of two recently released reports relating to water quality.

Call for Reform of RMA Process

In December 2011, Local Government New Zealand released a paper entitled "Enhanced Policy Agility – Proposed Reform of the Resource Management Act"[1]. This paper presented a case for removing de novo appeals to the Environment Court for plan and policy changes and for making other improvements to the process (such as streamlining s.32 reports and the way plans and policies are written; removing non regulatory methods from plans; ruling out late or off-topic submissions; and requiring evidence at the time of submission[2]).

The paper argues that these reforms:

- Are necessary to enable local authorities to develop and implement resource management plans and policies quickly enough (ie within one three year electoral cycle) to be able to provide a meaningful response to new national instruments and changing resource uses and effect.
- Will ensure that public plan and policy decisions are made by elected representatives who reflect the values of, and are accountable to, the local community.
- Will bring the Environment Court into alignment with other Courts which do not have the jurisdiction to make public policy decisions.
- Are more consistent with local authority powers under other legislation – there being no right to a de novo appeal.
- Will encourage participants to put their best case forward at an early stage and serve to limit anti-competitive behaviour.
- Will reduce the risk of Council officers or councillors changing mid way through a plan change process.
- Will significantly decrease delays and the opportunity costs associated with those delays.
- Will significantly decrease the costs associated with plan changes (by eliminating appeal costs) for Councils and for other parties.
- Will not jeopardise the national interest as the government can make its position clear through the enactment of national instruments and/or position statements.

While removal of de novo Environment Court appeals (and other plan and/or policy improvements) were raised as part of the 2009 streamlining and simplifying amendments they were not proceeded with at that time. With phase 2 now being underway and calls being made for a more fundamental reform of the RMA (as well as other proposals for local government reform – noted below) it is possible that these proposals could now gain further traction. We will watch developments with interest and report back on any movement in future articles.

Local Government Reform Proposals

"Better Local Government"[3] is an eight point reform programme which was released by the government in March 2012. The programme is directed at improving the focus, efficiency and fiscal management of local government in New Zealand. The proposed reform measures are:

1. A refocusing of the purpose of local government - from the broad requirement to look after "social, economic, environmental and cultural wellbeing" to the narrower requirement to provide "good quality local infrastructure, public services and regulatory functions at the least possible cost to households and business".
2. Introduction of fiscal responsibility requirements – such as soft caps limiting expenditure growth to inflation plus population growth and linking these measures to new graduated powers of central government intervention – ranging from the provision of information to the appointment of a commissioner or early election.
3. Strengthening of council governance provisions – including empowering councils to set policies on the number of staff to be employed and overall remuneration; increasing mayoral powers to allow the mayor to appoint deputy mayors, establish committees, appoint committee chairs and to propose plans and budgets; and the introduction of a graduated scale of intervention linked to the fiscal responsibility requirements (noted above).
4. Streamlining of council reorganisation procedures – including extending the criteria to cover the benefits to be gaining from simplifying planning processes; to give greater weight to efficiency improvements; and also to provide the Local Government Commission with greater flexibility in the determination of ward boundaries in rural areas.
5. Establishment of a local government efficiency taskforce to advise on streamlining and reducing the costs of local government planning, consultation and reporting processes.
6. Development of a framework for guiding decisions on which regulatory functions are best undertaken by central and local government.
7. Investigation of the efficiency of local government infrastructure provision, and in particular, how good quality infrastructure can be delivered at least cost.
8. A review of the use of development contributions – including consistency (or not) of application and whether they are adversely impacting on business, job growth, and housing affordability.

Measures 1 to 4 are proposed to be actioned first so that any council reorganisation proposals can be considered in time for the 2013 local government elections. A relatively tight legislative timeframe is therefore proposed with the Government proposing to introduce legislation to implement these measures in May 2012 and to pass them into law by September 2012. The remaining measures (5 through 8) require more investigative work and are therefore proposed to be the subject of separate legislation to be introduced in 2013.

The paper notes that the reforms are necessary to reduce rates increases and to combat spiralling local government debt, which have been occurring since the previous 2002 local government reforms significantly broadened the purpose and functions of local government.

Predictably, reactions to the proposal have been mixed. While most have been supportive of halting rates increases and spiralling debt[4], others have been concerned about the flow on effect of these changes resulting in under-investment in infrastructure going forward[5]. Concerns have also been expressed that the proposed narrowing of the focus of local government will leave a gap in the

"While removal of de novo Environment Court appeals (and other plan and/or policy improvements) were raised as part of the 2009 streamlining and simplifying amendments they were not proceeded with at that time. With phase 2 now being underway and calls being made for a more fundamental reform of the RMA (as well as other proposals for local government reform – noted below) it is possible that these proposals could now gain further traction."

provision of social and other services unless central government steps in to pick up the slack[6]. There has been little reaction from the local government sector to date. While Local Government New Zealand has expressed the tentative view that the changes are largely constructive for the sector[7], the Mayor of Auckland, Len Brown has been quoted as saying that the reforms follow too quickly from the Auckland reform and Auckland needs a chance to settle in[8].

Of course, the situation has recently become more complicated with the resignation of Local Government Minister the Hon Nick Smith and the handing over of the Local Government Portfolio (at least temporarily) to Hon Gerry Brownlee. It is not clear yet what effect these changes will have on the reforms, other than perhaps a slippage in the timeframes proposed. We will maintain a watching brief on these reforms and provide updates in future articles.

Process on Freshwater Reforms

There has been very little to report in terms of progress of the freshwater reforms as many of the measures (such as the proposed National Environmental Standard on Ecological Flows and Water Levels) are on hold pending further advice from the Land and Water Forum. The Land and Water Forum is due to report in both March and September this year, but as at the date of writing this article, the March report was not yet publicly available.

One area where there has been some progress however, is in relation to funding of fresh water clean-up initiatives.

Freshwater Funding

In March 2012 the government announced a further $8 million of funding for the clean-up of polluted water bodies. Four water bodies have been selected to receive this funding. These are:

a. The Manawatu River – which is New Zealand's most polluted river, will receive $5.2 million. This amount represents approximately 17 per cent of the clean-up costs which include initiatives such as stream fencing and upgrading of sewage treatment plants.
b. Lake Wairarapa and Lake Onoke – will together receive $1 million, being 34 per cent of the total clean-up cost. Work will include improvements to farm fertiliser and effluent management, riparian fencing and planting, and the development of new wetlands.

c. Wainono Lagoon in coastal South Canterbury – will receive $800,000 which represents 29 per cent of the total project cost. The project includes riparian fencing and planting.
d. Waituna Lagoon in Southland – has been allocated $780,000, which represents a 50 per cent contribution to the clean-up cost. The project involves reconstructing eroding stream banks, rock strengthening of bends in the Waituna Stream and the construction of wetlands and sediment traps.

Water Quality Reports

Two reports have recently been released concerning water quality: a report by the Parliamentary Commissioner for the Environment ("PCE") on Water Quality in New Zealand[9], and a report by the Organisation for Economic Co-Operation and Development ("OECD") on Water Quality and Agriculture[10].

PCE Report on Water Quality in New Zealand

In March 2012 the PCE released a report entitled "Water Quality in New Zealand: Understanding the Science". The report is directed at understanding the science of water quality and does not analyse water policy or management and does not make any specific recommendations in relation to how to improve water quality. However, the report is interesting as it:

- Outlines the history of water quality in New Zealand[11].
- Identifies the three main pollutants of fresh water in New Zealand as being pathogens (comprising mainly human sewage and animal manure); sediments (being particles of soil or rock); and nutrients (such as nitrogen from farm animal urine, phosphorus from sewage, animal manure, household detergents, and fertilisers which contain nitrogen, phosphorus and potassium)[12].
- Notes the reasons (being flow, physical and catchment characteristics as well as ecological factors) that some water bodies are more vulnerable to pollution than others (e.g. lakes are more vulnerable than rivers as they act like sinks, rivers with small and stable flows are more vulnerable as they allow pollutants to build up, estuaries are more vulnerable due to their function, and shallow aquifers are more vulnerable as they are closer to the surface and not protected by sufficient layers of impermeable silt and clay)[13].
- Describes the methods being used to help protect and improve water quality (such as reducing pollutants going into pipes, treating sewage and manure, discharging wastewater onto land, avoiding use of excess fertiliser, reducing stock numbers or changing the way stock is managed, fencing off of streams, bridging crossings, riparian planting, and preserving and restoring wetlands) and notes that "there is no single solution that will work on everything everywhere"[14].
- Contains a case study of the Manawatu River (which as noted above is New Zealand's most polluted river)[15].
- Notes that once pollutants get into water bodies options for removal are both limited and expensive[16].
- Presents a four question approach (what are the pollutants, how do the pollutants get into water, where do the pollutants end up, and what can be done about it) that can be used for considering water quality issues[17].

The report is useful in understanding the cause and effect relationships between activities and pollution but stops short of volunteering an opinion about what should be done to address water quality issues. The next report noted below however does offer some suggestions.

OECD Report on Water Quality and Agriculture

Also in March 2012, the OECD released a report entitled "Water Quality and Agriculture: Meeting the Policy Challenge". This report, which is supported by a number of background reports[18], examines:

(a) Linking policies, farm management and water quality;
(b) Recent trends and prospects for water pollution from agriculture and the implications of climate change; and
(c) Case studies of policy experiences from a number of OECD countries including New Zealand.

The report notes that agriculture is often the main source of water pollution (for example it notes that in New Zealand point sources of water pollution have largely been addressed leaving diffuse sources such as agriculture as the dominant concern)[19], that the costs of addressing this pollution can be significant (estimated at billions of dollars annually across the OECD countries) and that policies to address water quality issues have often come up short[20]. After examining a number of case studies the report recommends adoption of the following measures to sustainably manage water quality in agriculture[21]:

- Using a mix of policy instruments rather than a single policy instrument to address water pollution. It is noted that water quality trading is one such instrument that could form part of the mix and that New Zealand has introduced such a scheme for Lake Taupo[22].
- Enforcing compliance with existing water quality regulations and standards.
- Removing policies that raise producer prices or subsidise input use as these encourage farmers to increase production and use more inputs and hence place greater pressure on water systems.
- Encouraging farmers to internalise their environmental costs through implementation of the polluter pays principle.
- Setting realistic water quality targets and standards for agriculture.
- Improving the spatial targeting of policies to areas where pollution is most acute.
- Assessing the cost effectiveness of different policy options in order to more effectively address water quality in agriculture.
- Taking a holistic approach to agricultural pollution policies which can help avoid adverse environmental effects and encourage co-benefits.

> "While we consider that the [OECD] report raises some interesting and topical issues and solutions for discussion, it pays very little attention to the benefits that flow from agricultural activities, the impact that the adoption of these measures could have on those activities, the need for industry buy-in and the consequent need for a phasing in of any such reform measures. In our view, such matters are important considerations in order to ensure that any water management programme will function effectively in practice."

- Establishing information systems to support farmers, water managers and policy makers.

While we consider that the report raises some interesting and topical issues and solutions for discussion, it pays very little attention to the benefits that flow from agricultural activities, the impact that the adoption of these measures could have on those activities, the need for industry buy-in and the consequent need for a phasing in of any such reform measures. In our view, such matters are important considerations in order to ensure that any water management programme will function effectively in practice. As in New Zealand water is managed under the RMA agricultural sector stakeholders will continue to have a say on any water reform proposals prior to them being implemented. ■

Footnotes

[1]Local Government New Zealand "Enhanced Policy Agility – Proposed Reform of the Resource Management Act" (December 2011) LGNZ Regional Sector Group <www.lgnz.co.nz>.

[2]For a full list of suggested improvements refer to pages 9 and 10 of the paper.

[3]New Zealand Government "Better Local Government" (March 2012) DIA <www.dia.govt.nz/betterlocalgovernment>.

[4]See for example: TVNZ "Government looks to cap council spending" (19 March 2012) <http://tvnz.co.nz/politics-news/government-looks-cap-council-spending-4784679>.

[5]No right turn "A recipe for public squalor" (19 March 2012) <http://norightturn.blogspot.co.nz/2012/03/recipe-for-public-squalor.html>.

[6]See for example: Gordon Campbell "On the local government reforms" (20 March 2012) <http://gordoncampbell.scoop.co.nz/2012/03/20/gordon-campbell-on-the-local-government-reforms.html>.

[7]Refer: LGNZ "Local Government Sector Reforms" (12 March 2012) <www.lgnz.news/spotlight/index.html>.

[8]Refer: 3 News "Len Brown challenges local govt changes" (20 March 2012) <www.3news.co.nz/Len-Brown-challenges-local-govt-changes/tabid/1607/articleID/247302/Default.aspx>.

[9]Parliamentary Commissioner for the Environment "Water quality in New Zealand: Understanding the Science" (March 2012) PCE <www.pce.parliament.nz>.

[10]Organisation for Economic Co-operation and Development – Directorate for Trade and Agriculture "Water Quality and Agriculture: Meeting the Policy Challenge" (2012) OECD <www.oecd.org>.

[11]Ibid, refer chapter 2.

[12]Ibid, refer chapters 1, 3, 4 and 5.

[13]Ibid, refer chapter 6.

[14]Ibid, refer chapter 7.

[15]Ibid, refer chapter 8.

[16]Ibid, refer chapter 9.

[17]Ibid.

[18]The background reports, three of which relate directly to agriculture and water quality (Agriculture and Water Quality: Monetary Costs and Benefits across OECD countries, New and Emerging Water Pollutants arising from Agriculture, and Water Quality Trading in Agriculture) are also available from the OECD website.

[19]Refer to Organisation for Economic Co-operation and Development – Directorate for Trade and Agriculture "Agriculture and Water Quality: Monetary Costs and Benefits across OECD Countries" (2012) Organisation for Economic Co-operation and Development <www.oecd.org>, at page 22.

[20]Water Quality and Agriculture: Meeting the Policy Challenge Report, supra note 1, at page 9.

[21]Ibid, at pages 9 and 10.

[22]Refer to Organisation for Economic Co-operation and Development – Directorate for Trade and Agriculture "Water Quality Trading in Agriculture" (2012) Organisation for Economic Co-operation and Development <www.oecd.org>, at page 25.

Catchment Management – Making it Simple

Yvette Rodrigo and Claire Perkins – MWH New Zealand Ltd

A new framework is providing a consistent approach to New Zealand's stormwater catchment management planning – a challenge given the dynamic and unique environment of each catchment. With ten defined stages it follows a streamlined and efficient process that addresses ecological, social, cultural, amenity and economic objectives for managing water quality, water quantity and land use.

The Need for a Catchment-Based Approach

Stormwater management has historically revolved around draining land to enhance its productivity and potential for development. Whether discharged to land via rapid soakage systems such as soakpits or to surface water via pipes, the main objective was to dispose of stormwater quickly. Treatment of stormwater prior to discharge was rarely considered necessary especially for land-uses such as residential development, which was not considered to be a highly contaminative land-use.

Over the last decade however, with an increasing understanding of the impacts that stormwater discharges from urban catchments are having on the environment, the focus has changed from providing stormwater infrastructure based on rapid disposal to management systems that are designed to protect a number of social and environmental values. Within a catchment therefore, there may be a diverse range of stormwater management systems that provide varying degrees of stormwater treatment and attenuation.

Without an integrated and holistic view of stormwater management within a catchment, understanding the cumulative impacts of stormwater discharges on various receiving environments can be difficult and the adverse effects greater. A proliferation of individual stormwater management systems in a catchment can also place significant pressure on funding and resources available to stormwater network managers for maintenance and monitoring.

Catchment Management Plans

A CMP is effectively a planning tool that can be used to manage natural and physical resources on a catchment-wide basis. Resources may be subject to stress or pressure as a result of natural or anthropogenic factors. CMPs provide a mechanism for actively managing the impacts of these influences on the resources within a catchment.

Urban development can result in a range of impacts on social, cultural, economic and environmental values within a catchment. As a result, many District Councils and stormwater network managers around New Zealand are being encouraged by Regional Authorities to prepare CMPs. In some cases, for example in Canterbury, the preparation and implementation of stormwater catchment management plans are a statutory requirement under the rules of the Natural Resources Regional Plan (NRRP).

CMPs can focus on one particular stressor (e.g. stormwater) or can adopt a more integrated approach and include other factors (e.g. wastewater and water supply). The scope of the CMP will depend on the key drivers for the development of these plans.

An effective CMP needs to be easy to use and understand. It is likely to be used or referred to by many different people within a District Council, stakeholder groups, developers and the wider community. In order to be easy to use, the structure must flow logically and the user should be able to understand how the objectives, methods and outcomes of the CMP are linked together and were derived.

A CMP must also be adaptable. A rigid plan is not an effective way to manage catchments which in New Zealand are inherently dynamic, be it as a result of natural processes or development progress. As we have seen in Christchurch recently, planned development can be rapidly fast-tracked or significantly altered as a result of matters out of control of regional and local authorities or developers. In addition, information gathered by monitoring may result in changes to the objectives, methods and expected outcomes of the CMP.

The CMP Framework

The CMP framework was developed by MWH to assist District Councils and stormwater network operators to develop "fit-for-purpose" CMPs for new and existing development. It focuses on setting robust objectives for each catchment, collecting and analysing relevant and necessary information and developing stormwater management methods that will achieve the sought objectives and outcomes. To meet these objectives CMPs need to incorporate a large amount of information from planning, environmental and engineering inputs in order to provide methods and guidelines. The framework sets out a ten stage process for the development and implementation of stormwater CMPs, and the preparation of CMP reports to satisfy Regional Authority requirements. It details the various stages of CMP development, the anticipated outputs for each stage, the associated actions and who should be responsible for carrying out the tasks. The 10 stages of the CMP framework are shown in Figure 1 below.

Simplistically, the first four stages of the framework relate to setting the context and limits of the CMP. The next four stages work within these limits to prepare the detail of the CMP, including using the information gathered in previous stages to develop appropriate mitigation measures for the catchment and mechanisms for implementing these measures. The last two stages relate to implementation of the CMP and finally, monitoring the effectiveness of the plan.

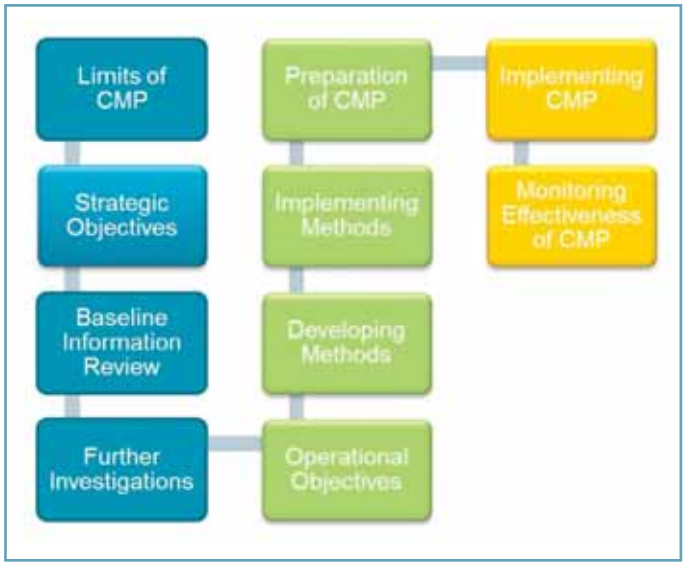

Figure 1 – CMP Framework – 10 stages to an efficient and effective catchment management plan

Briefly, the 10 stages are:

1. Defining the purpose and scope of the CMP. Key drivers are identified and the duration, scope and outcomes are set. Limitations must be well understood by all parties involved including Council staff, planners, engineers and technical experts. A large amount of data and information is collected

and analysed as part of the CMP development process and the Framework helps in efficiently managing information and documenting key decisions throughout the process.

2. Identifying the high level strategic objectives that are set out in either statutory or non-statutory documents. All relevant documents are reviewed during this stage and strategic objectives in relation to stormwater management within the catchment are identified.
3. Reviewing baseline information. The information assists in further clarifying the issues associated with stormwater management within the catchment, which will lead to the development of appropriate mitigation and stormwater management methods for the CMP. It identifies information gaps and any further work required. A consultation strategy and communications plan is developed during this stage.
4. Undertaking further investigations and assessments that may be necessary and to supplement any existing information previously obtained.
5. Establishing the operational objectives and specifically the outcomes that need to be achieved to effectively meet the high level strategic objectives defined in stage two. They take into account information relating to the issues and constraints associated with stormwater management within the catchment and the values that could be affected by discharges of stormwater. As an example, for a strategic objective that states that water quality should be maintained or enhanced, the operational objective could be that stormwater discharges from that catchment require first flush treatment or that discharges to water are not appropriate and discharges to land should be encouraged.
6. Developing stormwater management methods to achieve the operational objectives which may include mitigation measures provided by the Council, or by individual developers, floodplain strategies, stormwater bylaws or a public education programme.
7. Developing a programme of works to set out how to implement the identified methods.
8. Drafting the final CMP document. Following consultation and feedback, the CMP document is finalised and submitted to the regional authority.
9. Implementing the programme of works set out in the CMP in accordance with the Plan's timeframe.
10. Reviewing and monitoring the effectiveness of the CMP to test that the Plan is meeting objectives.

The development of a CMP can take months or even years depending on the size of the catchment and the issues that need to be resolved. In order to streamline the process of CMP development, MWH developed a Template Report to provide focus on the final deliverable from the CMP process. This document provides the details and results of each stage of CMP development.

The template report is closely aligned with the CMP Framework to reduce time and costs, as various sections of the CMP template report can be written once the various CMP stages are complete rather than having to collate and write the CMP document at the end of the process. As well as being tailored to reflect the size or the issues of a specific catchment, it provides consistency to ensure that various catchments can be compared.

Overcoming the Challenges

The CMP framework and report was developed by MWH in response to the requirement that Councils provide effective Plans either to satisfy legal planning requirements or to provide guidance to developers seeking advice on appropriate stormwater management measures. Many District Councils or stormwater network

"While the framework described here has focused on stormwater management by stormwater network operators, in particular District Councils, there is potential for wider uses of this framework."

operators are currently grappling with a number of challenges which this framework helps to overcome including:

- Lack of guidelines and national standards – The CMP framework and template report was developed by reviewing regional plans, global consent conditions, examples of CMPs and relevant technical papers on the preparation of CMPs. The framework and template report that has been developed provides a tool for managing the CMP development process. The framework essentially provides a checklist that enables those involved in preparing CMPs to stay focused on delivering a document with:
  - well-defined objectives and anticipated outcomes;
  - use of relevant and necessary information; and
  - methods to achieve the outcomes set for the catchment that have been derived through a robust analysis of the data collected.
- Prioritisation of catchments and cost, time and resources – For a stormwater network operator such as a District Council that may need to prepare multiple CMPs, the framework can result in a more stream-lined, efficient and cost-effective process. For example, some of the stages of a CMP, particularly the first few

stages relating to setting the limits, purpose and scope of the CMPs may only need to be undertaken once or the information used to develop strategic objectives for a catchment may be transferable to other catchments within a district.

- Expectation on the level of detail and content – The framework provides an indication of when consultation with key stakeholders, technical advisors and Council staff should occur throughout the process. Asking the right questions of the right people at the right time should ensure that there is a general acceptance of the level of detail and content of the CMP. The timing of consultation can also be crucial in ensuring all relevant information is used to inform the development of the CMP and reduces the risk of having to re-do work if key information is missed.
- Understanding of, and changes to, guiding development documents such as Structure Plans – Again consultation with appropriate parties involved in the Structure Plan process and effective communication during the first few stages of the CMP process should ensure that appropriate linkages between the CMP and Structure Plan are established.
- Who pays – The framework allows Councils to make informed decisions on the level of stormwater management they wish to provide within a catchment, primarily through allowing for consultation with key stakeholders during crucial stages of CMP development. In some situations it may be appropriate for developers within a catchment to provide more detailed investigations of environmental conditions or propose mitigation measures. Consultation should assist in determining the appropriateness and acceptability of this approach for a specific catchment.

Wider Uses

While the framework described here has focused on stormwater management by stormwater network operators, in particular District Councils, there is potential for wider uses of this framework. Examples include:

- Developers who wish to identify the most appropriate stormwater management measures to implement within their developments. Use of this approach would enable more streamlined discussions and agreements between developers and Councils to be reached as the reasons for the proposed measures would be clearly set out and supported.
- Mining catchments where integrated management of stormwater, land use, and wastewater is essential for safe and environmentally sustainable mining operations.
- This framework could also be applicable at the farm scale where Farm Environmental CMPs are becoming a more common and best practice method of managing farming activities and minimising the environmental effects of those activities.

By no means is this list exhaustive. The framework is adaptable to management of land use and water resources at any catchment scale, as the level of detail is able to reflect the size of the catchment, significance of the receiving environment and risk posed by the catchment activities.

Conclusion

There are a number of challenges associated with the development of CMPs in New Zealand. These challenges are generally associated with the need to prepare CMPs in a timely manner to keep up with development, the lack of standards to determine the content or level of detail required for CMPs and the amount of time, costs and resources that result.

MWH has prepared the CMP Framework and Template Report to assist stormwater managers prepare CMPs using a streamlined 10 stage process. The framework provides a means of keeping the CMP development process focused on the objectives that are set for a particular catchment by either statutory plans or by stakeholders within the catchment. They also provide consistency and comparability when stormwater managers are required to prepare multiple CMPs.

Measures are included throughout the ten stage process, that enable informed decisions to be made on the level of detail in the CMP and the extent of the investigations and assessments undertaken to develop the CMP for each catchment. The process includes consultation at key stages of development with the community and key stakeholders such as the regional authority to ensure that the end product is based on sound information and incorporates the expectations of other groups who are likely to influence the success of the CMP.

The CMP template report provides another mechanism for ensuring that a consistent approach is taken for the development of multiple CMPs. The template report is aligned closely to the CMP Framework, and therefore results in saving time, costs and resources by allowing sections of the CMP document to be written as various stages of the framework are completed.

> "Over the last decade, with an increasing understanding of the impacts that stormwater discharges from urban catchments are having on the environment, the focus has changed from providing stormwater infrastructure based on rapid disposal to management systems that are designed to protect a number of social and environmental values."

In the absence of best practice guidelines for the preparation of CMPs, the framework and template report structure may be used as a tool to ensure a more streamlined, cost effective and efficient process in the development of CMPs.

Acknowledgements

The authors wish to thank the management and staff at the Hamilton City Council, in particular Tim Harty and Raewyn Simpson, for their input and funding of the work that went into the development of this framework. Input from Graham Harrington at Christchurch City Council and Malcolm Loan at Invercargill City Council was also invaluable.

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Cities of the Future – an Urban River Park is Transforming Singapore's Water Infrastructure

Qihui He and Tuck Wai Lee – Project Managers – Active Beautiful & Clean Waters Programme, CH2M HILL

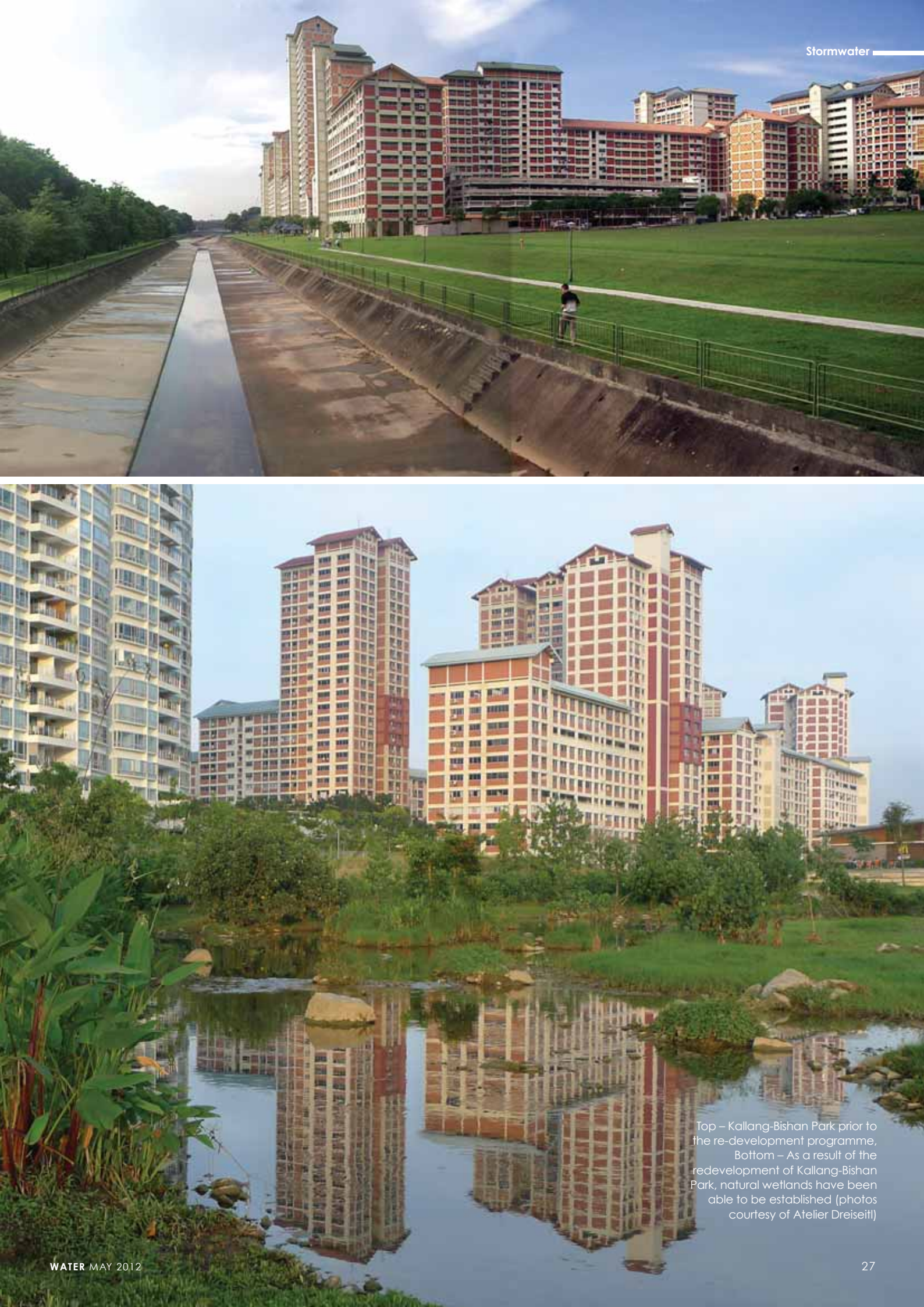
Integrating water into the city in a new and innovative way is the goal of the Singapore Active, Beautiful and Clean (ABC) Waters Programme implemented by the Public Utilities Board (PUB), Singapore's national water agency. PUB selected CH2M HILL and landscape architects Atelier Dreiseitl to create the master plan and deliver key pilot projects for Singapore's Central Catchment, consisting of five reservoirs and 12 major rivers, as well as thousands of kilometers of canals and drains. The ABC Waters Programme helps ensure a holistic, integrated approach to planning, designing, and constructing sustainable engineering solutions to convey storm-water and provide flood control.

Singapore is an island city-state with no natural aquifers and limited land area. Although the island receives generous tropical rainfall in excess of 2000mm a year, expansive development and significant population increase since the 1960s have meant the city has faced drought, flooding and water pollution. The 1970s saw the wide-scale conversion of Singapore's natural water system into concrete culverts and drainage channels, including the Kallang River. This hard engineering approach has proven insufficient to deal with the challenges Singapore's growing population grapples with today.

"Singapore is an island city-state with no natural aquifers and limited land area. Although the island receives generous tropical rainfall in excess of 2000mm a year, expansive development and significant population increase since the 1960s have meant the city has faced drought, flooding and water pollution."

The ABC Waters Programme was formally launched in 2006 with 20 projects being initiated over the first five years from 2007–2012 and 100 projects targeted by 2025. Strategic hydraulic and urban analysis resulted in the identification of key pilot projects and the creation of the "ABC Urban Design Guidelines" to ensure the widespread application of new, water sensitive, urban design approaches to managing rainwater sustainably throughout the city. Under the ABC Waters Programme, PUB aims to transform Singapore's reservoirs and waterways into beautiful and clean water bodies that bustle with life and activity.

A joint collaboration between PUB and the National Parks Board established the Kallang River-Bishan Park project with the goal of redesigning the existing park and integrating the Kallang River into the landscape. Bishan Park is one of Singapore's largest and



Top – Kallang-Bishan Park prior to the re-development programme, Bottom – As a result of the redevelopment of Kallang-Bishan Park, natural wetlands have been able to be established (photos courtesy of Atelier Dreiseitl)

"To create a healthy river environment extensive hydrologic and hydraulic modeling was performed on the catchment, the existing canal and the proposed river to ensure that the new river met or bettered the performance of the existing canal. The detailed hydrology from catchment delineation and upstream reservoir operations were analysed. Detailed 1-D and 2-D hydraulic models were then created for the canal and the proposed new river."

most popular parks, with the local significance of New York City's Central Park. The park typically receives three million local visitors per year and is located between two neighborhoods – Ang Mo Kio and Bishan – both major residential housing areas, which until recently were divided by the old concrete channel of the culverted Kallang River. The channel was empty most of the time, but would fill rapidly to a depth of up to two metres in a typical tropical downpour creating a dangerous liability.

The Bishan Park project is unique in that it is not only a redesign of an existing people's park, but aims to create a very close interaction with water and the Kallang River that runs along it. A series of existing ponds act as wetlands to improve the quality of stormwater. The existing straight edge concrete canal was demolished and reused to create a river that meanders through the park and integrates land and water boundaries. This was the first time a Singapore stormwater system was physically integrated into a land development to create a new experience for the community while maintaining the hydraulic function of the stormwater system.

To create a healthy river environment extensive hydrologic and hydraulic modeling was performed on the catchment, the existing canal and the proposed river to ensure that the new river met or bettered the performance of the existing canal. The detailed hydrology from catchment delineation and upstream reservoir operations were analysed. Detailed 1-D and 2-D hydraulic models were then created for the canal and the proposed new river.

Over the three kilometre reach, more than 100 cross-sections and more than 10 different bioengineering and stabilisation techniques were simulated to define the river. The model was calibrated by collecting field data. The proposed river model simulated design iterations, including features of the natural river, such as islands, bends, and transition zones, to ensure there would be no flood concerns, and to identify potential hydraulically weak zones and possible safety concerns.

Vegetated swales along the banks of the river help to stabilise the soil during high flow to prevent floods and erosion. The river banks are now teeming with wildlife and a remarkable 30% increase in biodiversity has been observed since construction began in late 2009. Sixty-six species of wildflowers, 59 species of birds and 22 species of dragonflies have been identified in Bishan Park. The restoration of the river has created a huge variety of micro-habitats which not only increases biodiversity, but also the resilience of species within the park.

The redevelopment of Bishan Park focuses on such sustainability factors as energy conservation, reuse of materials, and usage of green technology. Through recycling and reusing old materials, waste generation was significantly reduced. Much of the concrete canal that was demolished now forms part of the river bank. Sheltered areas of the park, such as toilets and rest points are designed to improve natural ventilation and lighting to reduce the energy needed to cool or illuminate the areas.

Designed as a community-friendly park that caters to all Singaporeans, the 62 hectares of Bishan Park boasts many re-creational areas including three playgrounds, a community garden, two fitness areas, open fields, and even a dog run. Food and beverage outlets and shaded rest areas are also situated throughout the park to ensure that park goers can easily find a place to relax.

On March 17, 2012, the redeveloped Bishan Park, now renamed Bishan-Ang Mo Kio Park, was officially opened by Prime Minister Lee Hsien Loong. Also present at the opening were the Minister for the Environment and Water Resources, Vivian Balakrishnan, and former National Development Minister, Mah Bow Tan. The event was joined by CH2M HILL employees, whose family day was held in conjunction with the official opening.

"CH2M HILL has been helping Singaporeans improve their quality of living over the past fifteen years through its engagement with PUB's ground-breaking infrastructure projects," says John Quarendon, CH2M HILL Asia Regional Managing Director.

"We began by delivering the vital infrastructure of the massive $3.65 billion Deep Tunnel Sewerage System, a superhighway for used water collection, and the Changi Water Reclamation Plant,

The redevelopment has meant the Kallang River now runs through the park (photo courtesy of Atelier Dreiseitl)

"The Bishan Park project is unique in that it is not only a redesign of an existing people's park, but aims to create a very close interaction with water and the Kallang River that runs along it. A series of existing ponds act as wetlands to improve the quality of stormwater."

which was commissioned in June 2009, to support the 4.8 million and growing population into the next century.

The development of a NEWater demonstration facility followed by four other NEWater Plants® to utilise reclaimed water has also helped the island-nation close the water gap. Through these landmark projects in combination with the ABC Waters Programme, CH2M HILL and partners have been able to help Singapore meet its goals of cleaner waters around the island, a healthier environment for its citizens, and has enhanced the country's reputation as a global water high-tech centre."

The dynamic interplay of the park and river gives Bishan-Ang Mo Kio Park a new unique identity, engages local people and fosters a sense of communal ownership of the river but even more, the restoration work brings the water back to the people. ■

Optimising Infrastructure Design through 2D Modelling

Nadia Nitsche and Onno Ursem – Planning and Modelling Team, AECOM

Urbanisation often has a significant effect on flooding due to an increase in impermeable surfaces producing increased overland flow, and the installation of obstructions affecting natural flow paths.

The ability to accurately predict the route, volumes and velocities of floodwaters in these areas is becoming increasingly important because of the significant social and financial impacts when flooding occurs. In addition, the cost of carrying out flood mitigation works can be considerable making it essential that any proposed work achieves its desired objectives. This is not always an easy feat.

Highly urbanised areas come with a number of stormwater modelling challenges. These include: increased levels of topographical detail; complexity of terrain (i.e. roads, kerbs and inlets); interaction of the drainage network including inlets, pipes and engineered or natural open channels; as well as the presence of stormwater management structures such as ponds, stopbanks, pumps and off line storage devices.

Traditionally, 1D modelling has been the standard approach for stormwater modelling. However there are some limitations with this approach. One of these limitations is that the modeler determines the path the overland flow will take. This may be difficult to determine in flatter areas.

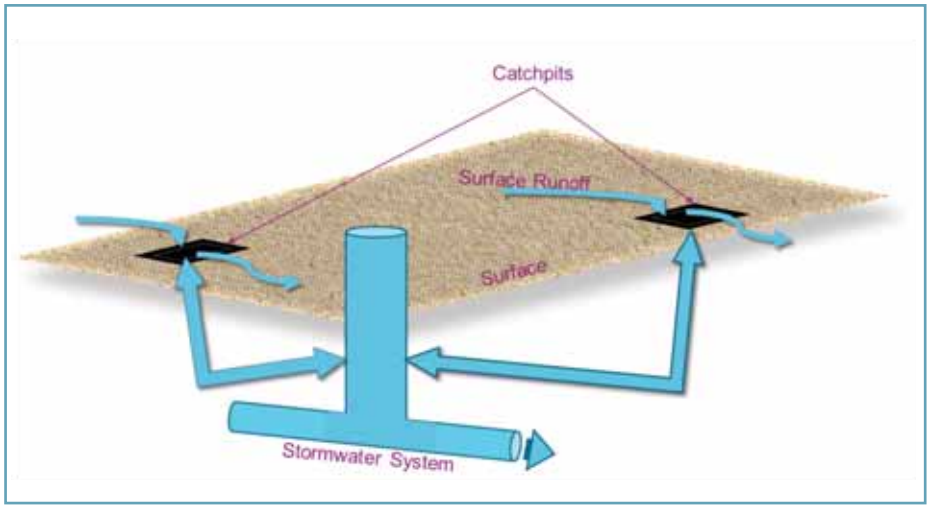
2D models, which have predominantly been widely used for coastal and river modelling are also now often integrated with 1D models to predict flood hazards within urban environments. These 2D models are able to predict the flooding more effectively by removing the subjectivity the modeler needs to apply to 1D models and allows the surface to determine the path the overland flow will take.

Another major assumption of all previous 1D modelling is that all the surface water can get into the drainage system if capacity is available. However the reality is that systems are often not well designed or maintained. Little is sometimes understood regarding inlet capacities and stormwater pipes are potentially underutilised due to insufficient inletting resulting in overland flows and flooding.

With the additional advances of the 2D modelling and the 1D/2D coupling options, the inletting of surface runoff through catch-pits has been made possible. The coupling can be regulated to control the maximum flow that can pass through the coupling at any particular time (Figure 1). For example, by using information from an earlier study, an inletting capacity can be assigned to each catchpit coupling in the model based on the type of catchpit. For instance, standard catchpits, max-pits and mega-pits are assumed to have an inletting capacity of 20 litres per second, 100 litres per second and 500 litres per second respectively. This has the advantage of indicating to a client whether or not the overland flow can enter the primary network through the existing inlets.

"The ability to accurately predict the route, volumes and velocities of floodwaters in these areas is becoming increasingly important because of the significant social and financial impacts when flooding occurs."

Figure 1 – Interaction between 1D pipe system and 2D surface runoff



In urban areas fully integrated 1D/ 2D modelling offers a major step forward in the prediction of flood extents through superior representation of the complex hydraulic processes. By analysing the subject area in detail using a coupled 1D/2D model and modelling the catchpit capacities, the infrastructure design can be optimised to significantly reduce construction costs and public inconvenience.

Case Study – Shopping Precinct Flooding

AECOM was recently commissioned to investigate localised flooding that occurs at a shopping precinct. This includes flooding of road pavement, footpaths, shops and basements.

Initial 1D modelling of the area and indicative flood mapping of the results suggested that the existing stormwater infrastructure was inadequately sized to cater for runoff during an extreme storm event (10 year ARI or greater). It was concluded that large (600mm diameter) stormwater pipes were required, and the capacity of existing inlets increased at key flooding locations, to prevent excessive surface flooding and subsequent floor and basement flooding. AECOM was engaged to assess whether or not a lower cost solution was available.

AECOM proposed to investigate the area in detail by undertaking site inspections of the existing pipes and carrying out a detailed 1D/2D model to more clearly define the relationship between pipe capacity and inletting capacity of catchpits.

The 1D and 2D model of this area represented stormwater pipes as a 1D system with connections to the overland 2D surface regulated by the catchpit inletting capacity. The low-lying areas as well as the critical overland flowpath between the buildings were represented in the 2D model. The complexity of road kerbs was also represented in the 2D model.

When undertaking the detailed 1D/2D modelling of the shopping area, the following was identified:

1. Additional overland flows were predicted to enter the area as a result of overland flow from an adjacent road, which had not been identified in the original 1D model and therefore had not been accounted for in the original design.
2. Some inaccuracies were found in the existing service plans, which had a significant impact on the assumed capacities of the network, and potential flooding in the area. During the detailed investigation, a large diameter pipe was discovered on site, and another existing pipe was found to be a lot larger than as shown on the service plans. These pipes were found to have sufficient capacity to be able to alleviate flooding in the area without the need for a lengthy network extension.
3. By modelling the inletting capacity of the catchpits in the area, it was possible to analyse whether the catchpits were sufficient to drain the surface runoff into the drainage system. The locations of catchpits were obtained from GIS and from site visits. It was found that in some areas the pipe capacity was not the constraint, but rather the inletting capacity. In particular, catchpit leads were found to cause a significant constraint in inlet capacity due to many being only 150mm in diameter, very shallow, and interconnected.

Figure 2 – Predicted surface flooding in shopping precinct

As a result of the updated 1D/ 2D model findings, the extent of remedial works required was reduced by more than 50%. As the work would involve excavating through hard basalt rock on a main arterial road in a busy shopping precinct, the reduction in cost, as well as public inconvenience, is considerable.

The Challenges of Monitoring Urban Stormwater

Peter Stephens – AWT New Zealand Limited

Introduction

Urban stormwater flow monitoring projects have been commissioned on a limited scale for many years in New Zealand. Projects have been undertaken haphazardly with little attention paid to monitoring specifications, data accuracy or project duration. Flow monitoring was often seen as a costly task that often produced poor or irrelevant data that got in the way of developing a good stormwater computer model.

There is now a greater focus on stormwater flow monitoring as the data that is captured provides the inputs to:

1. Quantify contaminant load on receiving waters (flow x contaminant concentration)
2. Develop hydraulic/hydrological computer models to verify that levels of service (LOS) are being met under present and future conditions
   - Pipe networks, bridges and culverts – 20 year ARI storm
   - Buildings – 50 year ARI storm
3. Develop computer models to determine flood hazard maps (typically to a 100year ARI storm)

Early Stormwater Monitoring Methodology

Wastewater flow monitoring equipment and practices have traditionally been applied to urban stormwater flow monitoring. Stormwater level is measured using an ultrasonic sensor or pressure transducer and velocity measured using a continuous wave Doppler sensor mounted in the invert of the pipe or channel. Discharge is computed using the Continuity equation (Velocity * Area). This is methodology, in concept, is excellent for determining an accurate discharge because of the ability of the flow monitor to account for variable and backwater conditions.

However, in reality the stormwater flow data captured was rarely of sufficient accuracy for accurate stormwater model calibration for many reasons:

1. Continuous wave Doppler velocity sensors measure peak velocity not average velocity. The peak velocity needs to be indexed (often stage-related) using velocity profiling techniques. Often very difficult and potentially unsafe to obtain storm calibrations coupled with an unwillingness for flow monitoring contractor to perform these calibrations. A typical solution, in the absence of comprehensive gaugings, was to either apply a 0.9 correction factor to all the velocity data or undertake low flow gaugings and apply this velocity correction factor to all the velocity data.
2. The continuous wave Doppler velocity sensor measures velocity in a very narrow band. This may be acceptable for smaller diameter pipes (<600mm) but doesn't provide any confidence that the 'true peak' velocity is being located and recorded in large concrete culverts and natural streams that may have flow widths exceeding 10 metres.
3. Monitoring periods were usually 10–12 weeks over the winter months to maximise the chance of obtaining a number of storm events and minimise the cost of the monitoring project. Whilst this is a sound strategy for obtaining a larger number of storm events, the storm events captured typically were smaller than those captured in summer.

"Often modeller's were forced to calibrate a model to a six month ARI storm event but extrapolate the model to predict network capacity issues & flooding extents in 20, 50 and 100 year ARI events. The results of the models often led to poor capital expenditure decisions and prioritisation as well as inaccurate flood hazard mapping."

Poor flow monitoring data was the catalyst for obtaining poor stormwater models. Often modeller's were forced to calibrate a model to a six month ARI storm event but extrapolate the model to predict network capacity issues & flooding extents in 20, 50 and 100 year ARI events. The results of the models often led to poor capital expenditure decisions and prioritisation as well as inaccurate flood hazard mapping. The implications of the inaccurate flood hazard mapping varied from:

- Economic loss – house owners and property developers having their land listed in council registers as being flood prone reduced capital value and prevented further/planned development
- Damage/loss of assets – flooding of buildings, homes and roads
- Catastrophic – potential loss of life

Overview of NSCC Stormwater Gauging Locations

AWT operates a stormwater flow monitoring network in the North Shore of Auckland. The current monitoring network is 13 gauging stations consisting of six open channel concrete culverts and seven natural watercourses. A crump weir has been previously installed at each site to provide a control as well as allowing fish passage (a requirement of the Regional Council).

The concrete culverts have dry weather base flows of <20l/s. In major storm events these slow, shallow flows rapidly become raging torrents of water with water velocities exceeding 3m/s and some flows exceeding 70m^3/sec. A stage rise exceeding 0.5m/10min is not uncommon. An example is provided in Figure 1.

LOOKING THROUGH THE CRUMP WEIR – START OF STORM

LOOKING UPSTREAM OF WEIR – 15MIN AFTER HEAVY RAINFALL

Figure 1 – Hillcrest stormwater gauging station – dry/wet weather flows

Figure 2 – Eskdale stormwater gauging station – dry weather flow

The natural watercourses are more typical of small stream gauging sites with dry weather base flows of <50l/s (Figure 2) and storm flows of around 10–15m^3/sec.

NSCC Stormwater Monitoring Methodology

The major non-technical problem associated with using area-velocity flow monitors for stormwater monitoring is cost. Area-Velocity flow monitoring equipment is expensive and requires extensive maintenance. The gauging contractor has to pass on the capital and labour costs to the client. Clients struggle to understand why the monitoring is so expensive considering that only a fraction (normally less than 1%) of the data is ever utilised in developing a stormwater model.

AWT's solution is to use a crump weir as a control and to install a stilling well above the 100 year flood level with multiple inlet pipes into the culvert/watercourse. A shaft encoder with float/counterweight is used for recording stage.

Stage, ambient and stream temperature data is logged at five minute intervals. Data is sent real-time to the AWT server using GPRS telemetry where the HYSDTRA SVRIMP module is utilised to import the data into HYDSTRA. The data is displayed to the client via a Google-map (Figure 3) based interface using web tools to chart and provide statistics from the data stored in the HYDSTRA database.

Figure 3 – Google-map with NSCC stormwater gauging and rainfall monitoring sites

Clicking on site markers brings up stage, discharge, temperature and rainfall charts for user-defined periods. All the historical data is also accessible (Figure 4).

"The major non-technical problem associated with using area-velocity flow monitors for stormwater monitoring is cost. Area-Velocity flow monitoring equipment is expensive and requires extensive maintenance. The gauging contractor has to pass on the capital and labour costs to the client. Clients struggle to understand why the monitoring is so expensive considering that only a fraction (normally less than 1%) of the data is ever utilised in developing a stormwater model."

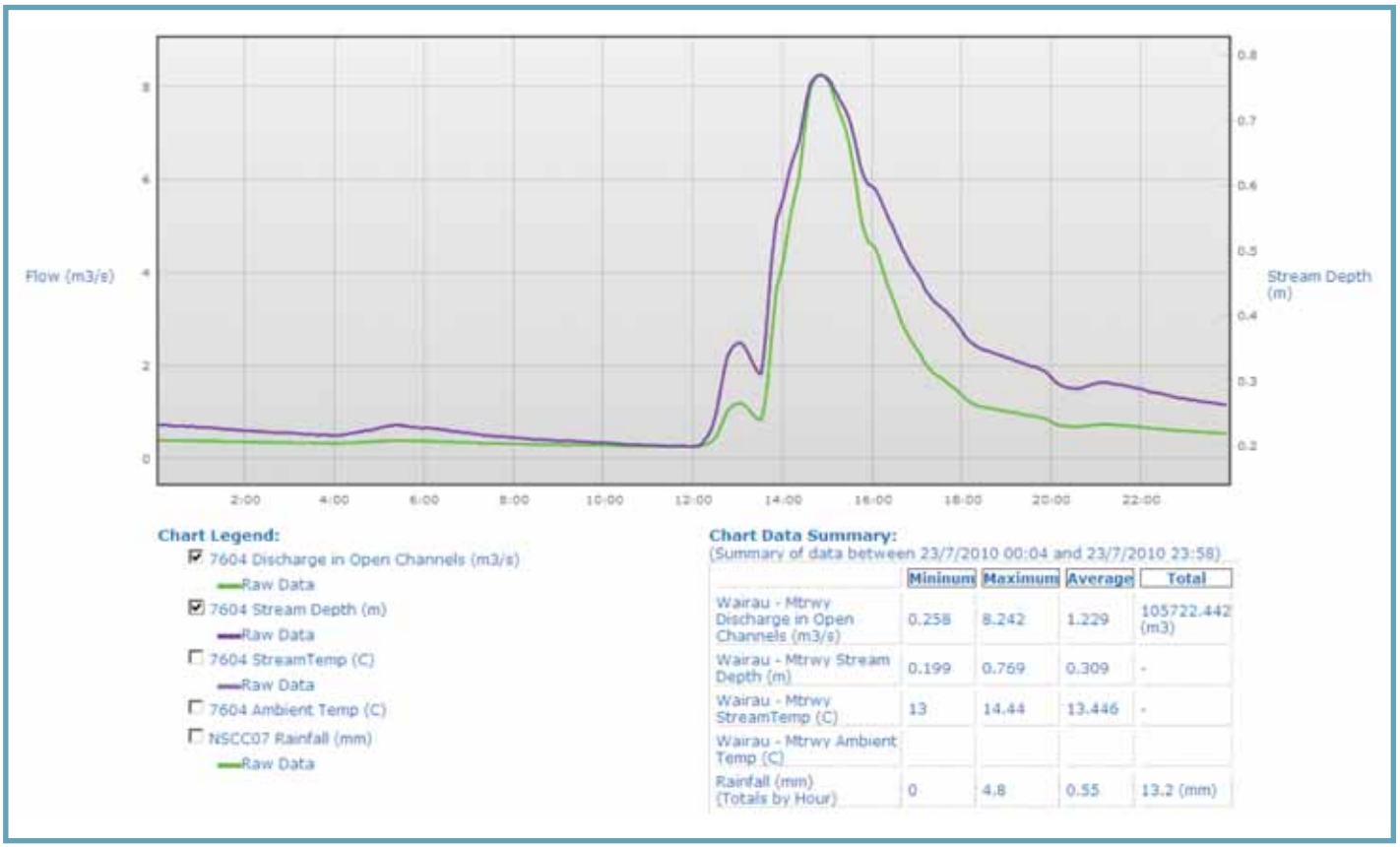


Figure 4 – Stage and discharge data presented via web-based access

SMS alarming is utilised to alert field crews to storm flow conditions – the alarms can be triggered on stage, discharge or rainfall total. It is the experience of AWT that real-time alarming is the only effective means of ensuring rapid mobilisation of field crews for storm flow discharge measurements.

Stage – Discharge Ratings

Low (Dry Weather) Flow

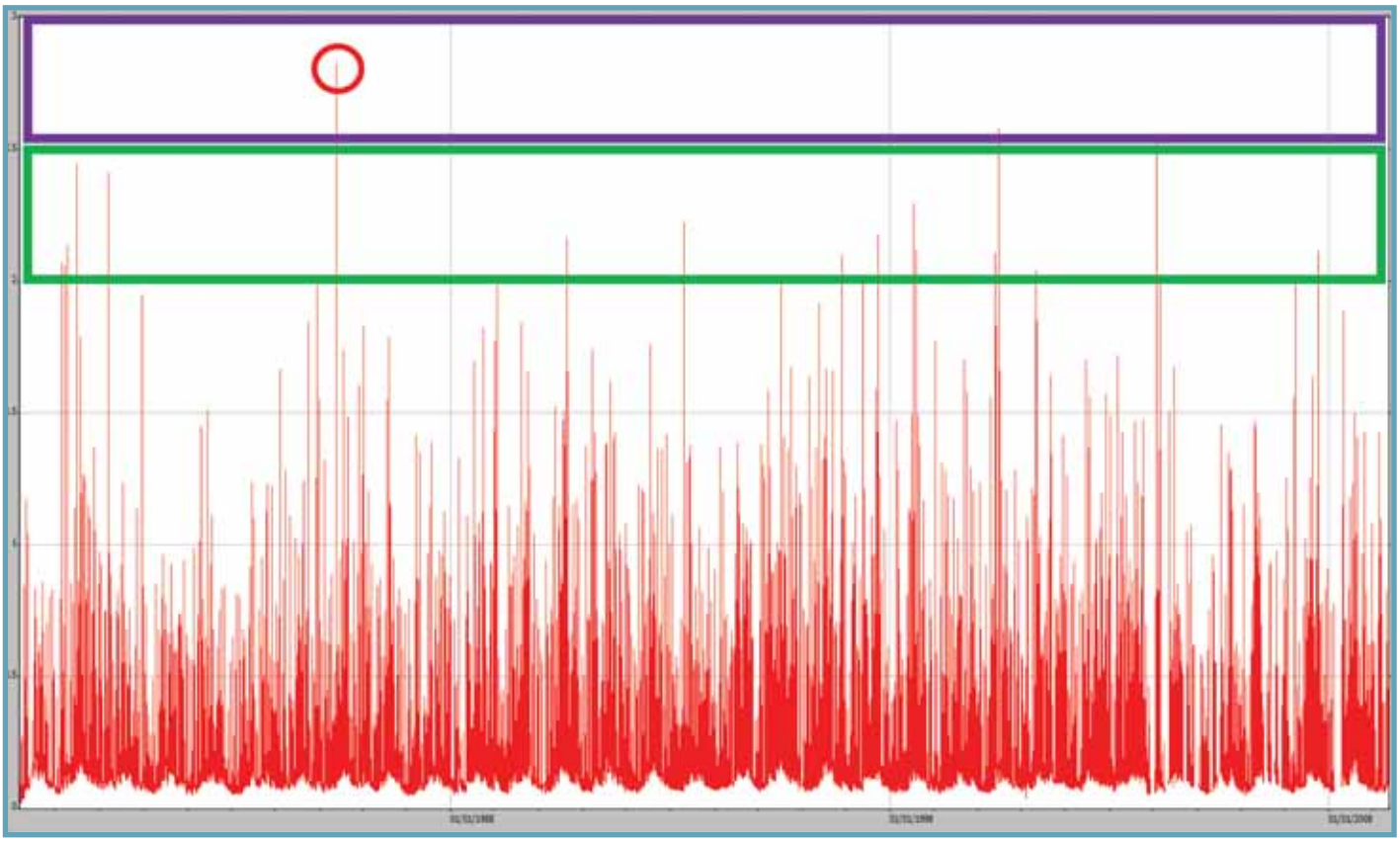
All of the NSCC stormwater monitoring sites have dry weather flow rates <50l/s so the low flow part of the stage to discharge rating is derived by either constructing a temporary 90° v-notch weir or through discharge measurements using a current meter. The accuracy of the rating under low flow conditions is usually unimportant in the stormwater model so the focus is placed on obtaining flood gaugings.

Storm (Flood) Flow

Project Scope – The client wants a high level of confidence in the stage and discharge data during extreme storm events.

Problem 1 – Figure 5 illustrates 30 years of stage data from a NSCC stormwater site. The green box illustrates storm events that resulted in a stage increase above two metres (discharge of approximately 40m^3). There have been 15 events in 30 years or an ARI of two years. Although useful for model calibration, it is well below the minimum level of service for designing stormwater networks. The purple box illustrates storm events that resulted in a stage increase above 2.5 metres (discharge of approximately 70m^3). There have been two events in 30 years. The stormwater model was calibrated to the 1986 event (circled). To summarise: there are very few opportunities, even with long-term gauging to capture and calibrate extreme storm events.

Figure 5 – 30 years of stage data from site 7604 (Wairau Motorway)



"SMS alarming is utilised to alert field crews to storm flow conditions – the alarms can be triggered on stage, discharge or rainfall total. It is the experience of AWT that real-time alarming is the only effective means of ensuring rapid mobilisation of field crews for storm flow discharge measurements."

Problem 2 – Storm duration – unlike large river systems where the flood recession may take many days, urban stormwater flows normally peak and recede very quickly giving little opportunity to mobilise and obtain flood gaugings. The largest event captured in the North Shore (1986 event) had a stage rise of 0.05m/min with a total time spent above 2.0 metres stage of 90min. Of this 90min, the stage exceeded 2.5 metres for less than 30min and the entire event (stage rise and fall above/below 1 metre) was over in four hours.

Problem 3 – The width of the stormwater flow was approximately 12 metres during the 1986 event. Although a cableway is present the time taken to mobilise and set-up would mean that it is unlikely that a discharge measurement would be obtained during flood extremes. Even reducing the number of verticals, limiting the discharge measurement to a 60% reading and reducing the exposure time to 20sec, it is unlikely that a full width velocity profile could be obtained during steady flow conditions.

Problem 4 – At many sites there is no cableway or structure (bridge) across the channel so the only practical means of discharge measurement is wading. The rapid changes in stage, very fast stormwater velocities makes wading measurements unsafe during extreme events.

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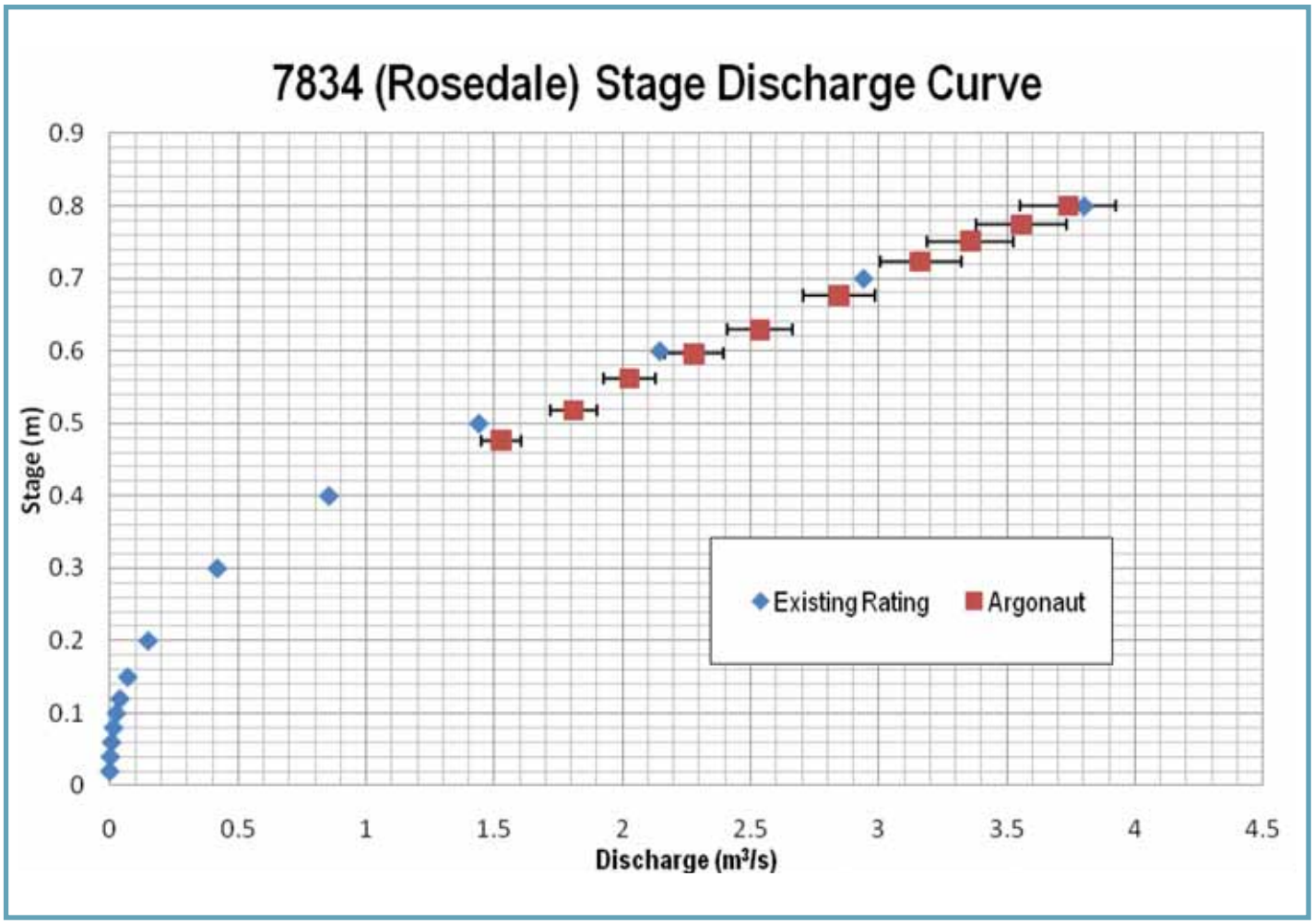
Storm Flow Discharge Measurement – AWT Experience

1. AWT has opted to not obtain discharge measurements using current meters for all the technical and safety reasons noted above.
2. At three of our natural watercourses rock shelves, stream confluences and small drops are present upstream of the gauging station. At two of our culvert sites there is a confluence of two piped flows upstream of the gauging station. These upstream conditions were considered to be ideal for salt dilution gauging. We employed the slug injection method using both dry salt and a saturated stock solution to determine whether either methodology yielded more consistent results. Our findings were:
   - Dry salt was easy to pre-weigh and transport to the slug injection site.
   - Overland flow in natural watercourses and piped inputs in culverts limited the distance that we could go upstream for the salt injection point. As a guide we used the equation, $M_s = 0.13 * A * \delta_c$, where M_s = mass of salt, A = estimated cross sectional area and δ_c = increase in conductivity above background (Measuring glacial outflows using a computerised conductivity system, Kite G., 1994) to establish the salt injection point. Complete mixing was verified by installing a conductivity sensor either side of the channel at the gauging location and checking that both conductivity readings were consistent.
   - Salt mass and slug injection volume could be accurately calculated using existing/theoretical ratings. We found that 2kg dry salt/m^3 flow was ideal. We successfully obtained repeatable salt dilution gaugings in flows ranging between 1–3m^3/sec.
   - Did not get consistent gaugings at a site with 9m^3/sec of flow despite the injection point being 250m upstream of the gauging station. Suspect salt concentrations were too low so the peaks of the conductivity curves were barely (2–3 times) above background. Calculating area under the conductivity curves had a high degree of uncertainty.
   - Avoid the first flush. The initial runoff from urban stormwater contains the impervious surface contaminants. We saw the biggest spike in conductivity before any salt was injected!
3. AWT decided against the use of constant rate dye or salt injection methodology because of the difficulty in transporting large volumes of stock solution to the injection site in storm conditions. The urban environment means that storing stock solutions at the injection site isn't feasible due to the high possibility of vandalism or theft.

4. AWT has used temporarily installed SonTek Argonaut-SW & ISCO ADFM monitors at some sites to assist with the development of stage to discharge ratings. Our evaluation is:

- In trapezoidal concrete culverts, even using a theoretical flow calculation rather than velocity index, captured data and subsequent stage to discharge ratings are within ±10% of the established rating (Figure 6).

Figure 6 – Stage to discharge rating comparison (existing vs. Argonaut-SW)



"The use of shaft encoders for the collection of long-term stage data at urban stormwater sites is cost-effective and reliable."

- The rating comparison in natural watercourses isn't as good due to the more complex hydraulic conditions and the fact that the Argonaut-SW is sampling a small percentage of the total flow.
- At sites with no existing stage to discharge rating, even using a theoretical flow calculation, the data captured forms a basis for discharge calculation until discharge measurements can be obtained.
- The acoustic Doppler instrument captures data 24hr a day, seven days a week so short-duration, extreme storm events are still captured.
- Acoustic Doppler data highlighted backwater conditions and loop hysteresis at some sites that have been established for many years placing into question the accuracy of historical data and the suitability of the gauging station long-term.
- Stationary acoustic Doppler instrumentation is still too expensive for permanent deployment in projects that have many gauging stations. As equipment costs come down and the technology gains acceptance it is likely that it will eventually replace the traditional shaft encoder gauging station.

5. AWT has undertaken preliminary trials using a SonTek S5 Acoustic Profiler for discharge measurements. Evaluation of this Acoustic profiling equipment is not conclusive but our current thoughts are:
   - Rapid storm responses means that use of RTK GPS (precise earth-referenced positioning) is not feasible as set-up time and satellite acquisition takes too long and RTK coverage in New Zealand is very intermittent.
   - The narrow width of the NSCC stormwater gauging sites (3–12m), even under storm flow, precludes the use of the differential GPS function as sub-metre accuracy is too coarse.
   - Heavy reliance on bottom tracking function – concrete culverts and natural watercourses with rock shelves/low sediment load appear to be the most likely sites to use the technology. Where moving beds are a possibility (approx. 30% of sites) the technology will be of limited use.
   - Although the S5 acoustic profiler can cope with the observed high velocities (3–4 m/s), the practical considerations associated with obtaining transects without air entrapment, violent pitching (sensor coming out of the flow) and cavitation is yet to be assessed.

Conclusion

The use of shaft encoders for the collection of long-term stage data at urban stormwater sites is cost-effective and reliable. GPRS telemetry and the internet have made the dissemination of real-time data to a wide array of users possible. The establishment of stage to discharge ratings is more problematic due to the rapid changes in stage, high velocities and relatively short event durations. Old fashioned techniques of salt dilution gauging (dry salt slug injection) have proved useful in storm flows up to 3m^3/sec. Use of stationary ADP measurements to collect a wider range of storm events has proven to be an excellent method for developing and validating stage to discharge relationships. Developments in moving boat, acoustic profiling for shallow water appears to be the future for making discharge measurements at urban stormwater sites.

Urban Waves – A Look at Flood Freeboard for Hamilton City

Ian McComb – Growth Specialist (Waters), Hamilton City Council

Reviewing the on-the-ground impact of the subdivisional and building codes in relation to secondary flowpath freeboard has led Hamilton City Council (HCC) to investigate an alternative approach for potential inclusion in its future Draft District Plan and Infrastructure Technical Specifications. Initial inclusion of higher freeboard requirements in development requirements led to resistance from the local development industry. Consequently after some consultation, calculation and internal reality checks, a revised risk-based freeboard proposal was developed. This is presented below for general information and to elicit further feedback from interested parties. For simplicity this article is focussed on residential dwellings.

> "As HCC has not yet determined comprehensive city-wide flood levels, individual site determination is required. Consultants are available to undertake the flood level calculations but the local development industry has not been used to including this in their proposals for infill redevelopment and hence resist on the basis of cost and time."

What the Codes Say

The New Zealand Building Code (NZBC) requires[1] that the 2% annual probability (50 year) storm shall not enter housing and communal buildings. The Building Code Compliance Document for the NZBC E1 – Surface Water (E1) requirement is that, in the absence of more accurate data from the territorial authority[2] a freeboard of 500mm be provided to the "floor level" where the water depth is at least 100mm and an unobstructed direct line extends between the building and road/carpark that would allow a vehicle generated wave to reach the building[3]. If one of these criteria does not apply then 150mm freeboard is all that is required (the same as for low risk sites under Acceptable Solution E1/AS1).

NZS 4404:2010 Land Development and Subdivision Infrastructure requires[4] that a freeboard be provided to the building platform or the underside of the floor structure. The freeboard shall be as specified in the District Plan or 0.5m above the computed 1% (100 year) Annual Exceedance Probability (AEP) Design Storm for habitable dwellings. The 4404 definition of freeboard allows for waves but also calculation and construction inaccuracies and localised effects in the flow channel.

The proposed Waikato Regional Policy Statement[5] is seeking to avoid development within the 1% AEP[6] and denotes high risk flooding criteria without tackling freeboard directly.

Thus two standards apply as shown in Table 1:

Table 1 – Freeboard Code Design Criteria

Design Criteria	E1 standard	4404 standard
Storm event	2%, 50year	1%, 100 year
Residential Freeboard	0.5m	0.5m
Freeboard reference	floor level	ground or under-floor

On-the-Ground Issues

The freeboard standards have highlighted a range of challenges for the development industry including issues associated with:

- Calculation of appropriate flood levels
- Impact of finished contours and associate earthworks costs
- Transferring the requirement to the future owners/builders via Consent Notice or Covenant

As HCC has not yet determined comprehensive city-wide flood levels, individual site determination is required. Consultants are available to undertake the flood level calculations but the local development industry has not been used to including this in their proposals for infill redevelopment and hence resist on the basis of cost and time. The simplified rules presented in the codes fail a reality check based on scale as the same 0.5m freeboard exists for a cul-de-sac catchment of 12 houses that will usually generate only channel full flow as the Waikato River that will rise 7+ metres.

Earthwork impacts of freeboard requirements are compounded as HCC has a preference for keeping overland flow paths with roads rather than private property and assuming primary system blockage. Consequently in a 1% event, most roads will have more than 100mm of flow down the channel. This effectively means all houses adjacent to a road need to have a floor level 500+mm above the kerb. Looking at this in cross-section terms for a typical urban section with 3m set back behind a 4.5m berm there is 7.5m to rise 500mm i.e. by having a raised floor or by grading the surface at 1:15 or 6.7% which is a relatively high grade for most of the city which is relatively flat.

As 4404 provides for building platform or underside of floor structure as applicable, industry feedback has indicated confusion as to what the standard reference point is. Experience has shown that once this is clarified the developer can determine the required floor level. Subsequently they decide whether they are going to raise the section height to achieve the freeboard or simply pass the requirement on to the future owner/builder. The legal means to transfer the requirement has focussed on consent notices and covenants, each of which have their advantages and neither of which get read by some owners/builders.

An Alternative Approach

To help overcome the above the following responses are currently proposed:

- Require design for the 1% event for secondary flow in greenfield developments and where possible for infill developments. However, some will require notices on title under the Building Act S72-74[7] as retrofitting many development sites to the 1% event is not a viable proposition within the city.
- Refer to "Finished Floor Level" (FFL) as dealing with builders has indicated that this is the language they like to speak. Therefore the proposed freeboard tables below have adopted a maximum level 175mm above the nominated 500mm to cater for floor thickness.
- Require a catchment specific freeboard based on risk factors or catchment size, secondary flow/ponding depth and velocity. The required freeboard FFL for residential dwellings, communal buildings and attached garages would be the highest value determined from Tables 2–4.

To support this approach HCC is in the process of producing a rapid flood hazard assessment that will provide depth and velocity information for the Council GIS that will avoid the need for many developments to do specific modelling.

Table 2 – Catchment Area

ha	mm
0.5<	175
0.5	185
1	200
2	225
3	250
4	275
5	300
6	325
7	350
8	375
9	400
10	425
11	450
12	475
13	500
14	525
15	550
16	575
17	600
18	625
19	650
20+	675

Table 3 – Ponding Depth

mm	mm
<100	175
100-249	225
250-499	350
500-749	475
750-999	600
1000+	675

Table 4 – Flow Velocity

m/s	mm
<0.5	175
0.5-.99	300
1.0-1.49	425
1.5-1.99	550
2+	675

"As HCC has not yet determined comprehensive city-wide flood levels, individual site determination is required. Consultants are available to undertake the flood level calculations but the local development industry has not been used to including this in their proposals for infill redevelopment and hence resist on the basis of cost and time."

Costs and Benefits

The current "one size fits all" (i.e. 0.5m freeboard) approach used by the codes reduces the cost of modelling but increases the cost of compliance through additional earthworks or building elevation to meet the level. Whilst this is appropriate for many areas, HCC being a relatively small and mostly urban or future urban jurisdiction can justify the cost of modelling. Hence HCC has invested in initial flood hazard modelling of the existing urban environment.

The proposed alternative freeboard values, allows a risk-assessment based approach built upon modelling data to tailor the freeboard response to the specific catchment situation. As HCC will be able to provide developers with depth and velocity information for most infill developments, the impact of the new regime will be minimised.

For greenfield areas, developers in Hamilton are already required to show overland flow paths and flooding depths so the additional work required to use tables 2–4 is generally likely to compensated by the reduced direct or indirect cost of compliance with the lower freeboard.

Ian welcomes comments contact him via email: ian.mccomb@hcc.govt.nz

References

NZS 4404:2010 Land Development and Subdivision Infrastructure including amendment 1

Compliance Document for the New Zealand Building Code E1 – Surface Water including amendment 8.

Footnotes

[1]Clause E1.3.2

[2]Clause 1.0.1,

[3]Clause 4.3.1

[4]Section 4.3.5.2

[5]http://www.waikatoregion.govt.nz/Council/Policy-and-plans/Regional-Policy-Statement/Regional-Policy-Statement-Review/Proposed_Regional_Policy_Statement/

[6]Policy 13.2

[7]Refer to http://www.qualityplanning.org.nz/plan-topics/natural-hazards/appendix-10.php <http://www.qualityplanning.org.nz/plan-topics/natural-hazards/appendix-10.php> for description of the application of these clauses

A Flood Management Strategy for the Apia Central Area

Keith Frentz and Keith Caldwell – Beca International Consultants Ltd
with appreciation and acknowledgement to the Planning and Urban Management Agency, Ministry of Natural Resources and Environment, Samoa

Introduction

Flooding has had a significant impact on the development of Apia and, in particular, the Central Business Area. Uncontrolled flooding is an historical issue which continues to challenge the community every year during the wet season.

The project undertaken by Beca for the Ministry of Natural Resources and Environment in Samoa comprised two parts. The first part was to understand the existing situation and the second was to recommend a strategy to better manage flooding in the urban area.

Several reports have analysed the flooding problems in Apia and recommended civil works to control the effects. However, the upgrades to infrastructure only form part of the answer. Adequate systems for rainfall and flow measurements, weather forecasting, flood monitoring, emergency response and flood reporting also form key elements of the final strategy.

Key to the strategy is the identification of 'Flood Management Cells' or identified areas where flooding is a priority issue that can be isolated and managed in a cost-effective and efficient manner.

Striking similarities were noted between Apia and Thames and the lessons learned from implementing a similar flood management strategy in Thames, including identifying flood management cells, were applied to the Apia Central Business Area. Like Thames, acute flooding in Apia can occur only two to three hours after a rainstorm begins and rainfall intensities in Apia are 50% greater than in Thames.

The Existing Situation

The Apia Central Area is built on a low-lying flood plain at the foot of Mt Vaea and other inland mountains and hills. The inland hills are steep and the flood plain is very flat as well as being close to mean sea level.

The area is bound by the Vaisigano Stream to the east and the Gasegase Stream to the west and it is bisected by the Mulivai Stream. Two smaller streams – the Asaga and the Fugalei – flow through the western section of the area entering Vaiusu Bay close to the mouth of the Gasegase.

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The Vaisigano and Gasegase Streams rise on the main divide of Upolu at an elevation of about 1,100 metres above mean sea level (mamsl). They each have a catchment area of 25 – 32km^2 and have similar characteristics. Starting from the river mouth the bed slope is around 1 in 500 to 1 in 1,000 in the lower reaches (approximately 1,500m) increasing to 1 in 100 to 1 in 50 over the next 500m. This change of slope occurs at a bed elevation of 1.0 – 2.0mamsl. The cross sectional area of the channel of both streams is constant through the lower reaches and not surprisingly the flow spills out of the channel and flows through the adjacent residential areas. The Gasegase overflows into areas in the adjacent Asaga and Fugalei Stream catchments.

The central Mulivai Stream is located between Mt Vaea and the Vaisigano catchment to the east. The catchment area is 6.8km^2 and that is the smallest catchment of the Apia streams. The stream rises on the east side of Mount Vaea at an elevation of

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Above Left – Mulivai Stream, Apia, Samoa, Above Rig

approximately 800mamsl. The catchment has a narrow shape with a length of seven kilometres and a maximum width of one kilometre.

Starting from the river mouth the bed slope is around 1 in 500 for the first 900m upstream and then 1 in 50 to 1 in 100 over the next 800m. This change of slope occurs at a bed elevation of 1.0mamsl and is located at the Vaitele Street bridge. In events of approximately a one year ARI (Average Recurrence Interval critical duration) the majority of the flow spills out of the channel and flows overland through the adjacent residential area and into the Asaga and Fugalei Stream catchments. This overflow exacerbates the acute flooding problems in the Apia central area, in particular around the main market causing severe economic and social disruption.

Apia Central Area

ht – Hape Stream, Thames, New Zealand

Key findings in the study of the existing situation are that there are limited data available on rainfall events and stream water levels. Also flood warning and flood reporting procedures need to be implemented and, to as great a degree as possible, automated. In particular the use of telemetry equipment to transmit data from rainfall and water level instruments to 'controllers' on a continuous 24 hour, seven day per week basis would provide 'real time' data for flood warning, which can also be automated through email, phone call and text messaging systems.

Climate change is likely to have a significant impact on Pacific Island countries and Samoa is no exception, in particular as the flood plain is already very low-lying. Climate change is likely to affect the mean sea level as well as the intensity and frequency of severe storm events and cyclones. In future these same areas may be only 1.0mamsl or less and are likely to experience greater flood flows from inland catchments. The greater flood flows will come from an increase in impervious urban areas and possibly climate change.

Recommended Strategy

The understanding of the existing situation identified that the Apia Central Area is generally at risk from sea flooding as well as flooding from inland streams. The tendency of floodwaters to spill from local streams and rivers, and the sea, has already had a profound effect on the layout of the customary and private land in Apia. However, it is not a practical solution to relocate the existing development in the Central Area to higher ground given the historic and on-going investment in infrastructure in this area. Flood management and, as far as possible, flood protection became the recommended strategy illustrated in a Pilot Project proposed for a priority area within the Central Area.

Drawing on our experience with a method of flood management that has been successfully applied to steep urban catchments in Thames, New Zealand – an area with much in common with Apia, as can be seen in the photographs below, Beca proposed a strategy that:

- Isolates distinct catchment areas preventing overflow from one catchment (or "cell") to the next
- Provides for flood protection to a 100-year ARI standard taking into account climate change predictions
- Protects against sea flooding

In both Apia and Thames the catchments are steep, the rainfall intensities are high and both urban areas are built on low-lying land with a history of sea flooding. The flood management strategy implemented in Thames provided continuous protection along each stream to a 100-year ARI height and a foreshore stopbank has been built along the town's shoreline. In periods of peak flood a pumping system forces water out of the flood plain area while sea waters are kept out by the foreshore stopbank enclosing the town.

With the stream sides and foreshore stopbank in place, the area between the streams is known as a flood management "cell". Once the management cell is in place more traditional methods of flood avoidance such as property filling and raising floor levels can take place if required over time as property owners redevelop.

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"Apia already has the beginnings of a flood management system. For example, the Apia Harbour seawall extends from the Port east of the Vaisigano Stream mouth to the end of the Mulinu'u Peninsula, the sides on the Vaisigano Stream downstream of the Leone Bridge have been raised and houses/businesses have raised floor levels and property levels, albeit on an ad hoc basis."

Apia already has the beginnings of a flood management system. For example, the Apia Harbour seawall extends from the Port east of the Vaisigano Stream mouth to the end of the Mulinu'u Peninsula, the sides on the Vaisigano Stream downstream of the Leone Bridge have been raised and houses/businesses have raised floor levels and property levels, albeit on an ad hoc basis.

The strategy proposes a more integrated management process that incorporates what has been done with future works in identified areas. The key to the strategy is to divide the problem into four manageable steps:

- Step One – Raise the sides of the first stream
- Step Two – Raise the sides of the second stream
- Step Three – Seawall along coast between the mouths of the two streams
- Step Four – Raise properties, upgrade internal drainage network

It is important to all stakeholders that the process can be broken down in this manner as it allows the staged implementation of a range of flood management solutions by both public agencies and private land owners. It also gives funding organisations confidence that the flood management measures being implemented are the 'building blocks' to a pre-determined level of flood management.

The method is also repeatable across several catchments, where those catchments experience similar flooding issues. This allows decision makers to prioritise and stage flood management projects across catchments as well as to evaluate the success/failure of this method of flood management and 'tune' the method to cater for unique problems.

Pilot Project

The area of Apia chosen for the pilot study experiences multiple flood problems and issues including overflow from adjacent catchments, overtopping of the internal network, inundation from the sea, poorly maintained and undersized drainage network. The study area is bounded by Vaea Street to the east, Vaitele Street to the south, Savolalo Street to the north and the Gasegase Stream in the west (see Map 2). The area is low-lying and it takes time for floodwaters to drain out of the area to the sea. Floodwaters from the area also migrate

Pilot Project Area, Apia

north into the neighbouring commercial area aggravating flooding issues in that area.

The application of the 'flood management cell' system of flood management to the Pilot Project area follows the four general steps discussed above.

1. To raise the sides of the Mulivai Stream to stop overtopping into the adjacent catchment areas.
2. To construct a seawall to stop sea flooding and overflow from the Gasegase Stream
3. Flood pumping to reduce flood levels to the capacity of the internal drainage network
4. Raise floor and street levels and establish flood walls to prevent overflow from this area to the commercial area to the north and upgrade internal drainage network.

These steps are prioritised in order of importance andconstructability generally as shown on Map 2. Item 1, raising the sides of the Mulivai Stream, is not shown as a project as it is considered to be an essential item that should be implemented before the other projects.

The 100-year ARI flood flow of the Mulivai Stream is 109 cubic metres per second and yet the capacity of the first bridge downstream of Vaitele Street is only a small fraction of that flow. This means the majority flow leaves the channel near the Vaitele Street bridge and heads downslope across Vaea Street toward Fugalei Street. Raising the sides of the Mulivai Stream and upgrading the two bridges downstream of Vaitele Street could upgrade the capacity of the Mulivai Stream channel to convey a 100-year ARI flood event without overtopping. Once the Mulivai Stream overflow is minimised, the next steps in the development of a flood protection cell for the Fugalei Street area can be implemented.

Priority Action 3, as shown on Map 2, is the construction of a stopbank at a height that prevents overflow from the Gasegase as well as preventing inundation from the sea. Floodgates are provided where the Asaga and Fugalei Streams cross the stopbank. Priority Action 4 provides for a flood pump at the Asaga Stream floodgate and Priority Action 5 provides an overflow channel from the Fugalei Stream to the Pump Station so that all of the drainage network in the area can be pumped from one point.

Priority Action 1 represents the "low-hanging fruit" and provides for culvert upgrades and other network improvements that may be needed to bring the internal drainage system up to a sound standard.

Priority Action 2, including 2a, 2b and 2c, as shown on Map 2, provides for a raised barrier between the Asaga and Fugalei Streams and the commercial area to the north. This has the effect of channelling all catchment waters to the Asaga Stream outlet and the pump station at that point.

Conclusion

Once these projects are implemented surface flooding should be minimised in the isolated flood management cell and property owners need only raise ground levels or floor levels when they redevelop. ■

Integrating Catchment Knowledge through Modelling

Colin Roberts – Managing Director, DHI

With the increased awareness of the impacts of natural and human activities on catchment infrastructure and ecosystems, Councils' focus must be on managing the effects of these activities in a truly integrated way.

Effectively integrating the combined knowledge of water movement contained within the many teams at local, district and regional councils to achieve this, however, can be a challenge. But it's key to effectively protecting the public and the environment, says DHI Managing Director Colin Roberts.

Maintaining our "pure" image is a multidisciplinary task needing a truly integrated approach

While a good number of Councils have comprehensive stormwater and wastewater flow management strategies in place, determining the effects of different types of water flow and quality on regional catchment resources and ecosystems are not always straightforward.

If the result and the impact of water movement under a range of different scenarios is to be soundly assessed, the widest possible range of studies needs to be brought together. For example, a single flood study can show discrete flood hazards and investigate possible mitigation measures. But if the longer term impact of that flood event on the hydro-ecosystem or the groundwater system is to be assessed then an integrated catchment study that is supported by a truly integrated catchment modelling approach is required – something DHI's MIKE SHE and ECO Lab software can deliver.

As populations grow, predicting water behaviour within a range of development options can also create unexpected difficulties. How related ecosystems might be affected and why the groundwater recharge interface is so critical is not always fully understood by all parties.

Both Councils and developers can benefit from a more holistic approach to assessing the results and impacts of water movement within the catchment. This is by no means an easy exercise to carry out as information, resources and knowledge can be fragmented within Council organisations.

Effectively integrating this huge body of knowledge to model water movement across a catchment area, and modelling the impacts over a number of years and a range of scenarios, is therefore critical for water engineers, planners and policy-makers alike.

"While a good number of Councils have comprehensive stormwater and wastewater flow management strategies in place, determining the effects of different types of water flow and quality on regional catchment resources and ecosystems are not always straightforward."

Truly integrated catchment modelling offers the industry the opportunity to collaboratively test a range of strategies and concepts before recommending a particular course of action. For example, MIKE SHE can predict the impact of changing land use over time on the quantity, and more importantly, quality of water within the different components of the catchment.

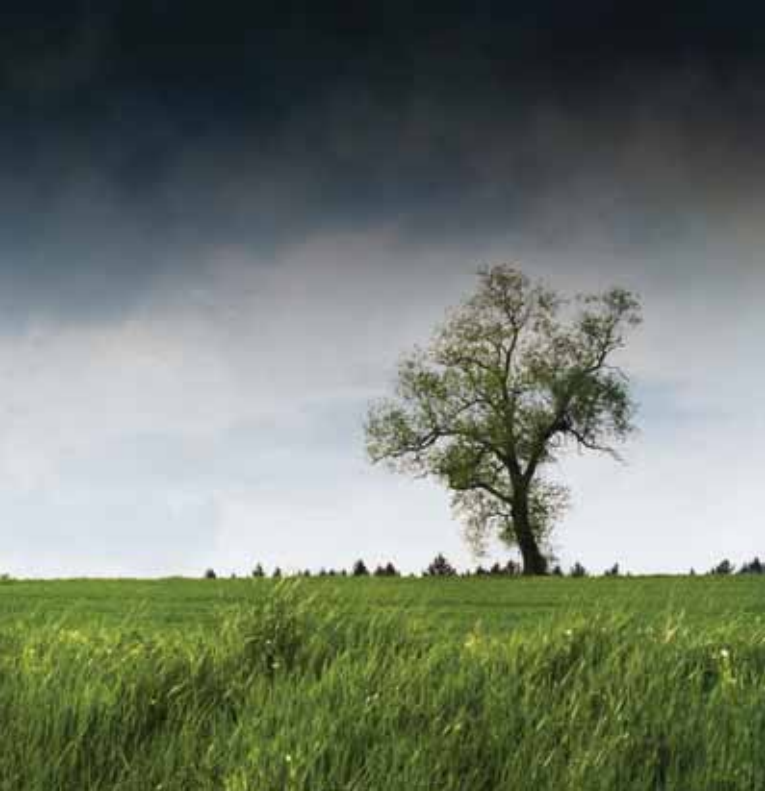
How useful such integrated catchment modelling software is obviously depends on the quality of information available to put into it. Councils can initially believe not enough data is available to make optimal use of such technology, but usually they have more than enough – it's simply a matter of different teams sharing their knowledge, according to Mr Roberts.

"A number of teams within a Council can be working on different aspects of the same situation within a catchment without having tools to assess the potential impacts of the combined efforts. Using a tool such as MIKE SHE and ECO Lab can overcome this challenge."

Like other divisions worldwide, DHI New Zealand is finding that part of its business is helping Councils realise how much they already know. This can take the form of staff and management training as well as demonstrating the benefits of their catchment modelling software.

"We work with organisations to help them on their journey realising the huge benefits that truly integrated catchment modelling will bring to the table," explains Mr Roberts. "To paraphrase Oscar Wilde – if you and I have a study each and we swap studies, we'll both still have one study. But if you and I share an idea, we'll both have two ideas."

Engineers and planners can extract the right information very quickly from this software, because it offers them seamless



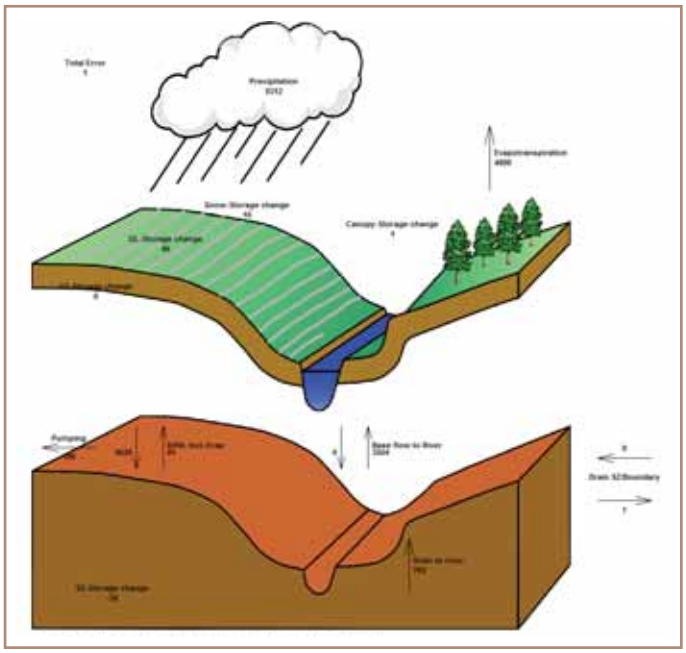
Land use change have major impacts on the environment

integration of all hydrologic processes. They're effectively delivered an interactive model of water's journey from sky to sea, showing the fate of water quantity and quality over time.

Studies around New Zealand are already showing very beneficial results.

"DHI is an independent, international consulting and research organisation," explains Mr Roberts. "Our objectives are to advance technological development and competence within the all fields of water and its environment. Because we're not-for-profit we are able to invest around 25 per cent of our human resources in research and development that ultimately benefit our clients. We're recognised globally for our innovation and expertise in water modelling and management."

DHI began life as a technological service institute funded by the Danish government in 1964 pioneering the use of computational hydraulic modelling. Development of what is now known as MIKE SHE started 35 years ago and is now arguably the world's leading integrated catchment modelling software. ■



MIKE SHE example including Water Movement/Balance and Water Quality

Aerators – The Superior Pak Range of Cage Rotor Aerators for use in Oxidation Ponds

Introduction

The use of Cage Rotor Aerators is rapidly gaining wide acceptance as an efficient and economical method of treating effluent which is discharged into oxidation ponds. These aerators have an almost silent operation to give speedy assistance to a naturally occurring biological process.

Tests carried out have shown our Cage Rotor Aerators to have a clearly superior oxygen transfer rate and greater mixing ability than that of aspirator type aerators, and is more efficient than the high speed splasher type machines.

"Through aeration from the top of the pond, the possibility of dragging sludge from the bottom is minimised. As a result any possible imbalance in bacteria production is also minimised. Sludge built up on the bottom of the pond should be dredged and disposed of as a separate operation."

Operation and Action

The ability to keep the top third of an oxidation pond mixed and aerobic is critical to its successful management. The Cage Rotor supplements the natural process by bringing the bacteria into contact with the sewage and keeping this top layer aerobic and mixed. This process prevents dead spots in the pond and in turn prevents odours, midges and eliminates public nuisance.

Through aeration from the top of the pond, the possibility of dragging sludge from the bottom is minimised. As a result any possible imbalance in bacteria production is also minimised. Sludge built up on the bottom of the pond should be dredged and disposed of as a separate operation.

We recommend mooring the Cage Rotor at the inlet end of the pond, to prevent sediment building up in that area. This area is also where the highest oxygen demand occurs.

In cases where multiple aerators are required in one pond, placement can be arranged to suit the most effective mixing patterns depending on the size and shape of the pond. In most cases Aerators are conveniently moored in a stationary position approximately 2.5m from an adjacent bank.

Design Features

The machine floats on pontoons which are fabricated from 3mm mild steel plate. The rotor is made up of eight helical-designed paddle arms mounted on the tips of four star-shaped end plates. The rotor is mounted to the pontoons via self-aligning flange mounted

bearings. The bearing mounts are of a robust construction and fully welded to the pontoons.

The rotor is driven by a shaft-mounted, geared motor. Levelling and height adjustment can be accomplished by filling the pontoons with water or by adjusting the rotor up and down via an adjusting screw mechanism on the bearing-mounted plates.

"We recommend mooring the Cage Rotor at the inlet end of the pond, to prevent sediment building up in that area. This area is also where the highest oxygen demand occurs."

A walkway between the pontoons allows for easy access from one side of the machine to the other and the design of the pontoons allows for safe walking over the length of the pontoons. All steel components are hot dip galvanised to protect against corrosion. All major components of the machine are quickly and easily unbolted allowing for ease of transport, assembly and dismantling for site transfer. The current range comprises 1.1kW, 2.2kW, 4kW, 5.5kW, 8kW and 11kW.

Advantages

- The machines we offer are currently operating in a wide range of locations throughout the country
- The modular design of the larger machines ensures that they can quickly and easily be dismantled for ease of transportation. The 1.1kW & 2.2kW are transported fully assembled
- Re-assembly on site can be accomplished easily and quickly
- Totally manufactured in New Zealand enabling prompt full parts and service
- Our Aerators are more efficient per kilowatt hour than those of our competitors ■

Contact our office for the latest additions to the range and the latest pricing and options.

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Richard Hancy – SKM's new Regional Manager, New Zealand

SKM Appoints New Regional Manager, New Zealand

Richard Hancy has been appointed SKM's Regional Manager, New Zealand, succeeding Andrew Croker who has moved to the role of Commercial Manager, Water and Environment. SKM is a projects firm, with global capability in strategic consulting, design and delivery operating in the Asia Pacific, the Americas and EMEA (Europe, Middle East & Africa).

Richard was previously the Regional Client Manager, Transport in New Zealand. With over 20 years' experience managing complex transportation projects in both the private and public sectors, Richard brings strong technical and management skills to the role.

In his new role he leads a national team of over 350 staff, operating across three sectors including Buildings and Infrastructure, Water and Environment, and Power and Energy. Richard will also maintain his role as Client Manager for the New Zealand Transport Agency (NZTA) to ensure SKM continues to be across the client's needs and priorities.

"I am delighted to be leading SKM's New Zealand business and look forward to building on the solid foundations we have established with our clients. As New Zealand's economy improves our clients are looking to grow and develop their businesses and SKM is in a strong position to support these initiatives."

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"The Christchurch rebuild is gathering momentum and SKM has an important and varied role to play, particularly as part of the Stronger Christchurch Infrastructure Rebuild Team (SCIRT). We will continue to focus our efforts on developing important infrastructure projects in New Zealand as well as working with our colleagues and clients on an international scale."

"Strong relationships remain critical to our ongoing success and I look forward to bringing my experience in the client relationship space to bear on a broader scale." ■

Stormwater Solution for Auckland's Victoria Park Project

Challenged with removing the last major bottleneck on Auckland's central motorway network, the New Zealand Transport Agency (NZTA) required a solution to reconfigure the existing Victoria Park flyover, widen the motorway through St Mary's Bay in each direction and form a 450m tunnel for three lanes of northbound traffic.

Stormwater360 were approached with the challenge of providing a stormwater quality improvement solution for treating contaminated stormwater runoff from the reconfiguration project which is one of the busiest roads in the country (about 150,000 vehicles per day) and passes next to the highly sensitive receiving environment of St Mary's Bay and the Westhaven Marina.

"With a tight construction timeframe as well as a lack of space for both situating a treatment device and constructing it, we needed a precast product that could be delivered to the site and installed readily and quickly," says Synergine Drainage Project Manager, Claude Dewerse.

"We also needed a product that could treat the runoff from a section of motorway that has one of the highest vehicle-per-day loadings in New Zealand. The solution proposed by Stormwater360 was the only product on the market that could deliver this for us."

SW360 proposed using StormFilters. StormFilter is the world's leading rapid filtration device with over 30,000 vaults installed worldwide and over 500 currently in New Zealand. The StormFilter cleans stormwater through a patented passive filtration system consisting of a structure that houses rechargeable media-filled filter cartridges.

The StormFilter works by passing stormwater through the cartridges which trap particulates and absorb pollutants such as dissolved metals, nutrients, and hydrocarbons.

The Victoria Park Tunnel Project uses seven StormFilter vaults with a total of 162 cartridges treating a total of approximately 7.8 hectares of motorway catchment. Each cartridge contains Zeolite, Perlite and Granular Activated Carbon media for suspended solid removal and enhanced dissolved metal removal.

> "Stormwater360 were approached with the challenge of providing a stormwater quality improvement solution for treating contaminated stormwater runoff from the reconfiguration project which is one of the busiest roads in the country (about 150,000 vehicles per day) and passes next to the highly sensitive receiving environment of St Mary's Bay and the Westhaven Marina."

"The StormFilter was the obvious choice for this site as it is ideal for contaminated catchments such as motorways," says SW360 Managing Director, Mike Hannah.

"StormFilters can be easily customised to suit site specific constraints such as topography, space limitations, services and hydraulic grade, and are also easy to monitor," says Mike.

The units were custom designed for the high sediment loading from the motorway

Above – New Zealand Transport Association Layout Plan for the Victoria Park Tunnel Project

and the limited hydraulic head available. Forty-six and 69cm cartridges were used to ensure there was no surcharge of the stormwater network.

The flow rate through the cartridges was also reduced to increase the sediment removal capacity and to enhance the dissolved metal removal by providing a longer contact time.

Stormwater Asset Manager for the Auckland Motorway Alliance, Peter Mitchell says that as well as being effective and easy to install, the solution had to be easily maintainable and cost-effective.

"From an operational perspective, StormFilters deliver a good whole-of-life value outcome for our Stormwater Management needs by effectively and efficiently delivering the right level of service and environmental compliance and performance.

"Importantly, the St Mary's Bay StormFilter assets have good safe off road access and will perform reliably for a consistent duration. We have good certainty about the timing, resource, and cost needs for the delivery of robust operational monitoring and maintenance activities for these stormwater assets".

The Victoria Park Tunnel is now open, and the newly widened motorway through St Mary's Bay is now fully operational as designed. ■

More information about the StormFilter treatment solution is available on the website www.stormwater360.co.nz

"The Victoria Park Tunnel Project uses seven StormFilter vaults with a total of 162 cartridges treating a total of approximately 7.8 hectares of motorway catchment. Each cartridge contains Zeolite, Perlite and Granular Activated Carbon media for suspended solid removal and enhanced dissolved metal removal."

Below – Stomwater360's StormFilter vault being lowered into place by crane, Bottom – Lid being installed to complete a StormFilter vault

Two World-Class Engineering Names Join Forces

CH2M HILL, a global full-service consulting, design, construction, and operations firm, and Beca's joint venture partnership, CH2M Beca, recently announced the acquisition of Halcrow Holdings Ltd., the UK-based engineering, planning, design and management services firm.

"The range of skills and services provided by CH2M Beca has been significantly expanded by CH2M HILL's recent purchase of Halcrow, including an increased depth of expertise in tunnelling and tunnel systems," says CH2M Beca General Manager, Clive Rundle.

CH2M HILL and Halcrow are both renowned for technical excellence and the ambitious, innovative projects they deliver. Clients in New Zealand and worldwide now have access to an even larger group of experts, further raising the bar for technical quality, project management and project delivery. This acquisition enables CH2M Beca to offer existing and prospective clients and partners greater local expertise and experience along with a broader range of services worldwide.

"Our local capability is further enhanced by our global outreach to the world's top tunnelling talent," adds Rundle.

"Our clients get the best of both worlds – world-class engineering solutions when and where they need them, designed and delivered to meet the requirements of New Zealand."

The combination of CH2M HILL and Halcrow results in a compatible, dynamic, client and partner-focused culture in line with CH2M Beca's mutual values of respect and delivery excellence.

About CH2M Beca

CH2M Beca Ltd is the joint venture company co-owned by CH2M HILL and Beca, specialising in water and wastewater project delivery in New Zealand.

About CH2M HILL

Headquartered near Denver, Colorado, USA, employee-owned CH2M HILL is a global leader in consulting, design, design-build, operations, and program management for government, civil, industrial and energy clients. The firm's work is concentrated in the areas of water, transportation, environmental, energy, facilities and resources. With US$6.3 billion in revenue and 30,000 employees, CH2M HILL is an industry-leading program management, construction management and design firm, as ranked by Engineering News-Record and named a leader in sustainable engineering by Verdantix. The firm has been named a FORTUNE 100 Best Companies to Work For five times and ranked number one in Trenchless Technology by Trenchless Technology magazine.

About Halcrow

Halcrow is one of the UK's leading consultancies, with a pedigree stretching back to 1868. The UK-based consultancy specialises in the provision of planning, design and management services for infrastructure development worldwide. With interests in transportation, maritime and property, the company is undertaking commission in more than 70 countries from a network of more than 80 offices around the world. Halcrow was named the 2011 International Tunnelling Adviser of the Year by New Civil Engineer. ■

Water New Zealand Conferences & Events

Trade & Industrial Waste Forum
8 – 10 August 2012
Rydges Hotel, Wellington, New Zealand
For more information visit www.confer.co.nz/tiwf

***Water New Zealand's* Annual Conference & Expo 2012**
'Water – Challenges & Opportunities'
26 – 28 September 2012
Energy Events Centre, Rotorua, New Zealand

For more information on *Water New Zealand* 2012 conferences visit www.waternz.org.nz/events

Other Conferences

ASTT Roadshow 2012 Masterclass
13 – 14 June 2012
Wellington, New Zealand
For more information visit
http://trenchlesslive.com/astt_roadshow

85th Annual Water Environment Federation Technical Exhibition and Conference
29 September – 3 October 2012
New Orleans Morial Convention Centre, New Orleans, USA
For more information visit www.weftec.org

Pacific Water Conference & Expo 2012
6 – 9 November 2012
Auckland, New Zealand
For more information visit www.pwwa.ws

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