



Watermark

Editorial



Clive Rundle - General Manager

In this NZWWA conference edition of Watermark, we wish to celebrate the position of engineers as history's creators and innovators. Leonardo da Vinci was arguably the greatest engineer in history and certainly one of its most celebrated artists, often combining the two into his forward thinking designs. It is with great pleasure that Beca has sponsored the da Vinci machines exhibition currently touring NZ and we invite you to join us at our NZWWA trade display which showcases da Vinci's designs.

As a profession that is founded on the science behind nature, there is art to be found in many of the engineering solutions we develop. Sometimes this takes the form of an elegant technical solution to a complex problem and sometimes it takes the more concrete form of architectural features on the large 'canvas' of our structures. I'm sure that many readers will identify with the pride that comes from association with such projects.

We hope that you will enjoy the articles featured in this edition of Watermark and look forward to your company at the conference!



Central educator tube, Christchurch Wastewater Treatment Plant (see Effective Mixing story inside)

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ENGINEERING IS ART

See great works of art and engineering, both past and present, at the CH2M Beca stand at the NZWWA Conference.

Enjoy a free can of V and build a da Vinci bridge.

NZWWA Conference
Stands 46 & 47

19-21 September 2007
Energy Events Centre
Rotorua



Beca, proud Patron of the da Vinci Machines New Zealand Tour 2007/08. See the da Vinci machines exhibition at museums around NZ: Palmerston North, Nelson, Dunedin, Christchurch



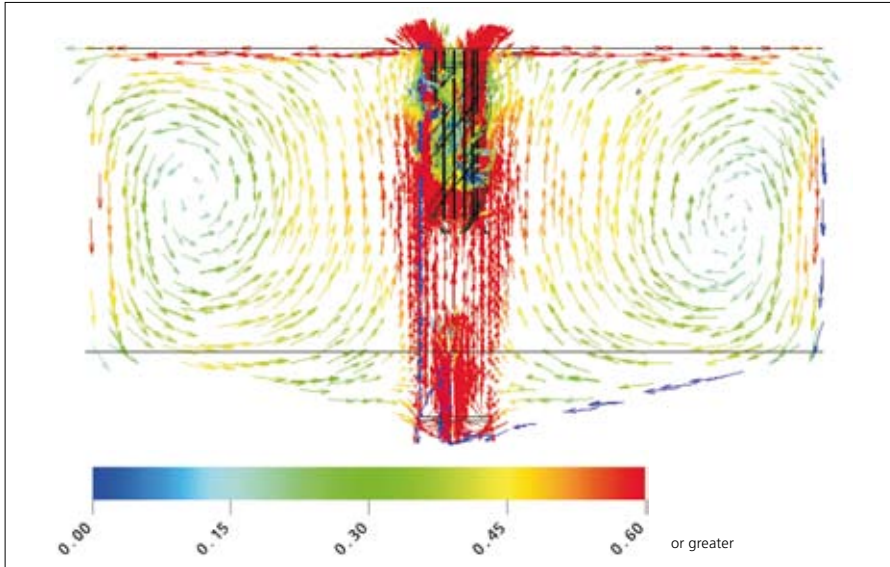
Building our world with clever thinking

The da Vinci Machines
New Zealand Tour
July 2007 - October 2008

Effective mixing

Using CFD to refine mixing design and achieve cost savings.

CH2M Beca recently partnered with Canterbury University's Chemical and Process Engineering Department to optimise the mixing of two new 7,000 m³ digesters at the Christchurch Wastewater Treatment Plant. The digesters are designed to be mixed by injecting the biogas into a confined central eductor tube that induces a toroidal roll current. However, only basic rules-of-thumb were available for sizing the mixing system. By modelling the mixing process with Computational



Sludge Velocity, m/s

Fluid Dynamics (CFD), design mixing flows were decreased by around 35%, reducing operating costs considerably as well as improving confidence and understanding in the mixing system, amongst other minor improvements.

CFD uses computer software to divide an enclosed volume into a number of finite volumes (cells). Then, given the system inputs, CFD solves the conservation of mass and energy equations for each cell, minimising any inconsistency. As a tool, CFD is mainly used for research or product development. Working with the University, CH2M Beca produced a low cost CFD solution. This arrangement should have excellent potential for any significant design project involving fluids, both gas and liquid. The CFD modelling results have enabled more refined mixing design and cost savings compared with the previous empirical methods that were based on an earlier physical model study also carried out by the University and Beca in the 1980's.

Associated with this CFD analysis, the University carried out tests on the viscosity of the sludge at the treatment plant. This enabled the CFD model to use the actual characteristics of the fluids involved and provide the treatment plant with more details of some of the process fluids.

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Preparing for the needs of a growing island population

Infrastructure upgrade project in Fiji: Suva, Nausori Package 4: Kinoya WWTP.

Beca Water's Wellington section has a long history of involvement in water and wastewater projects in Fiji. A number of successful projects have been delivered in partnership with local Fijian consultant, Erasito, under the banner of Erasito Beca Consultants Ltd (EBCL).

Fiji's capital, Suva, is home to approximately 130,000 people. Sewage from the city is treated at the Kinoya sewage treatment plant. This trickling filter plant, originally constructed in 1972 and augmented with an additional SBR stream in 2002, is struggling to cope with population increases that are forecast to rise to 250,000 by 2020. Additional loads from industry contribute to a design population equivalent of 356,000.

The Fijian government, supported by the Asian Development Bank (ADB), is to provide additional treatment capability at the Kinoya plant. Provided in two phases, this work has so far involved a condition assessment of the facilities on the site, an augmentation study to determine the extent of upgrades required, outline design of the stage 1 upgrade, specifications and tender documentation.

After-sales technical service in the country is difficult to procure and local maintenance capability is limited so outcomes have to be designed to be reliable with the minimum of complex maintenance requirements. Backed by experience, and the local knowledge of Erasito, our design engineers make design and equipment selection choices with this constraint in mind. For example, clarifier desludging is designed to operate on a timer basis using a progressive cavity pump. However, the facility for manual de-sludging is also provided so that the plant can continue to operate in case of failure of the control device or pump.

The first stage of this project, including a new inlet works, primary clarifier and sludge digester is due to be let under a design build contract later this year using Engineering Advancement Association of Japan (ENAA) conditions (recently adopted as standard by the ADB).

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Aerators at Kinoya plant, Suva

Manaaki Wai “Keeper of the Waters”

Six years ago, Beca was asked to assist New Plymouth District Council (NPDC) in planning for facilities in anticipation of DWSNZ (2005) and other specific challenges to water treated at NPDC’s existing plant. Beca conducted a workshop on water quality risk with Beca process experts, NPDC staff, one of Watercare’s process experts and a top international expert on threats to water quality posed by blue green algae. Beca followed with a pilot plant testing programme aimed at testing filter performance under potential operational regimes.

Workshops were held every 6 months to discuss topics ranging from current operational and compliance issues to the bigger picture expansion and upgrade, and action plans were formed. This process provided the necessary background data to form a sound basis for the expansion and upgrade. The workshop model proved to be an effective forum, combining the best of the operational knowledge of the plant operators and management with Beca’s water treatment process engineering experience. The main outcome was that the plant capacity was to be increased from an existing capacity of 46,000 m³/d to an upgraded capacity of 70,000 m³/d.

NPDC decided to procure the expansion and upgrade of the plant through a single design/build contract and Beca chose to bid the project as a subcontractor to Fulton Hogan. The Fulton Hogan/ Beca bid focused on maximising the value that could be extracted from the existing infrastructure, with some innovative adaptation of existing plant producing a clear winner in terms of cost and performance outcomes compared

with competing design-build submissions. The upgraded process includes:

- Powdered activated carbon dosing prior to the plant for minimisation of undesirable taste and odour,
- Pre-lime and CO₂ prior to coagulation for improved coagulation control and reduced water corrosivity,
- New inlet works constructed to cater for the increased capacity including an innovative hydraulic flocculation system that self-adjusts with varying flow to provide uniform mixing energy,
- Tube settlers installed in the existing clarifiers to achieve up to a 50% increase in capacity,
- Existing filters fully refurbished, including new floors suitable for a simultaneous air water scour system that provides improved filter washing and a filter to waste system,
- Sludge to sewer disposal system,
- New chemical dosing systems and control system.

The new processes are now installed and are performing well, with the balance of the filters and clarifiers being progressively refurbished in pairs to allow the continued operation of the plant. The plant will be fully commissioned by the end of 2007.

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Water Treatment

New Plymouth Water Treatment Plant Expansion and Upgrade.



Manaaki Wai

A methodology to meet the requirements of the RMA.

How wide is that stream?

Tucked away in the Resource Management Act 1991 (the Act) are provisions for setting aside esplanade reserve along streams when land is subdivided. However, powers to invoke these provisions hinge on whether or not the stream is wider than 3m. In many cases, there is no question. However, in smaller urban or peri-urban streams, this threshold can become a significant consideration, and has arisen as an issue for a number of councils. The outcome can be critical to councils achieving stream protection and ecological and walkway connectivity objectives in developing areas.

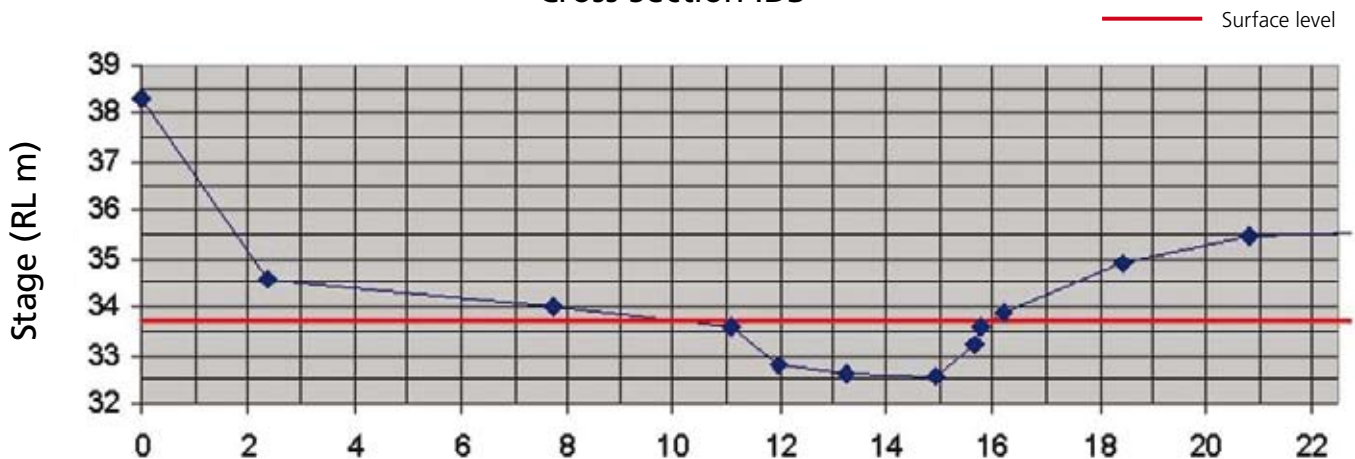
Recently this situation arose for North Shore City Council (NSCC), and Beca was asked to develop a robust methodology for determining stream width in the context of these provisions in the Act. A search of available information did not reveal any established guidelines. Even standard survey practices are a little vague and are not based around the explicit wording in the Act, which also includes a hydrological component. Furthermore, the matter does not appear to have been tested in the Courts. Therefore, Beca

returned to first principles and worked with NSCC staff and their solicitors to arrive at a survey and hydrological solution that complied with a legal interpretation of the Act.

The key phrase is the definition of the bed of a stream (in this specific context) being the area occupied "at its annual fullest flow without overtopping its banks". For surveyors and hydrologists this still leaves some room for interpretation, both of what constitutes "annual fullest flow", and in some stream forms, what constitutes "without overtopping its banks". Beca have come up with a methodology that combines both specific targeted survey, and hydrological and hydraulic modelling, to define water surface width at a number of points on a stream. This methodology was applied in the North Shore case to settle the NSCC's query regarding a particular stream designated for esplanade reserve.

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Cross Section ID3



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