water

AUSTRALIAN WATER ASSOCIATION
ABN 78 096 035 773

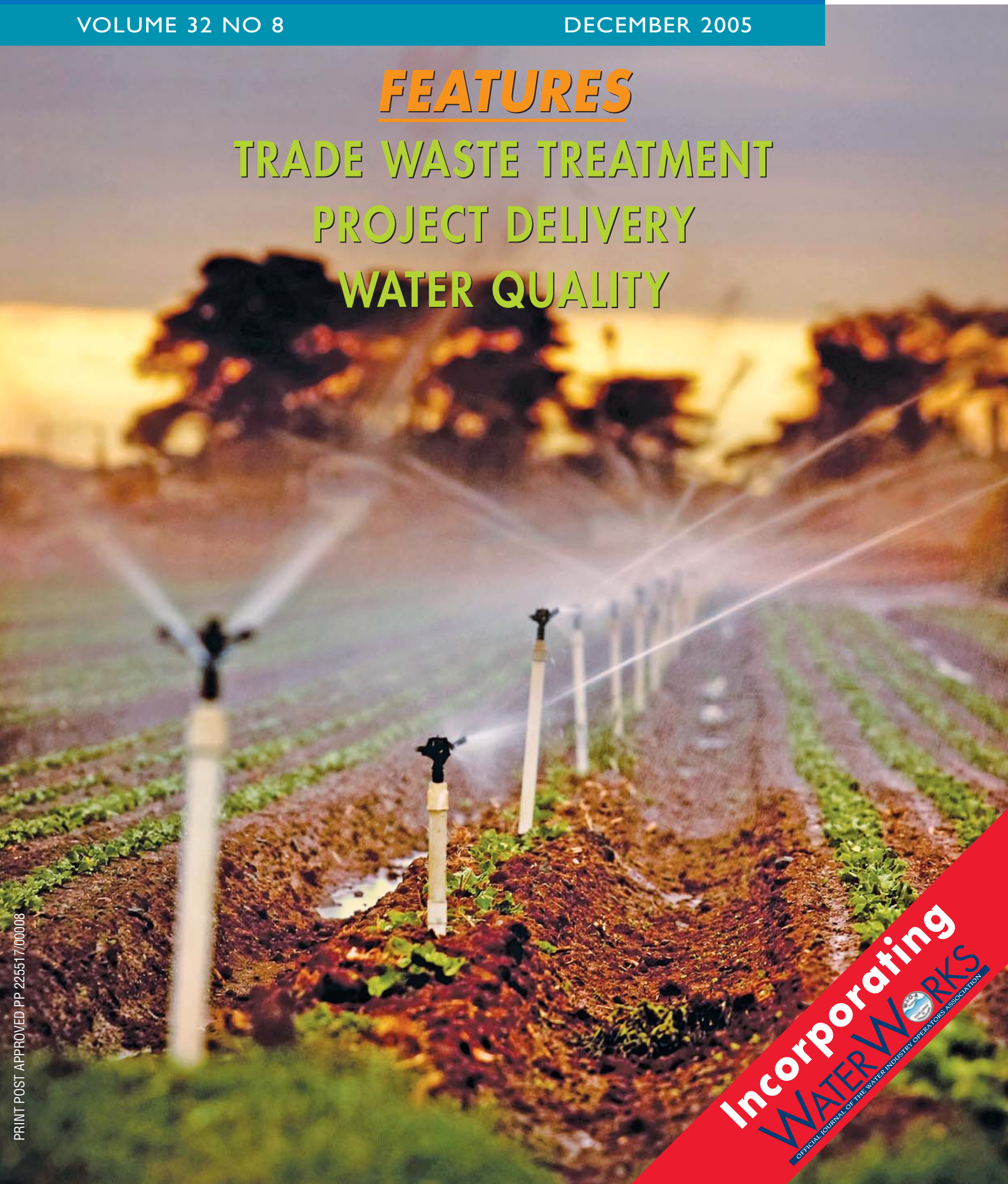
VOLUME 32 NO 8 DECEMBER 2005

FEATURES

TRADE WASTE TREATMENT

PROJECT DELIVERY

WATER QUALITY



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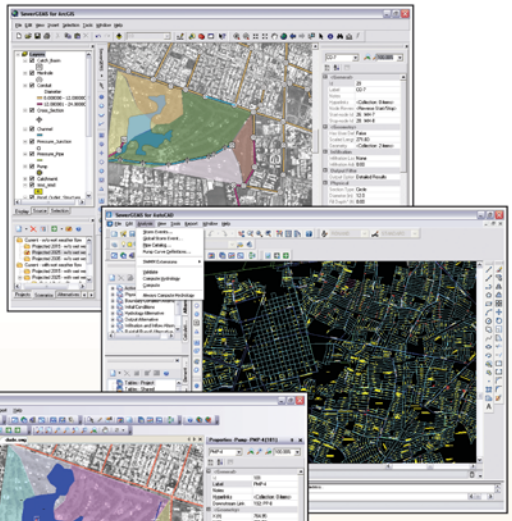
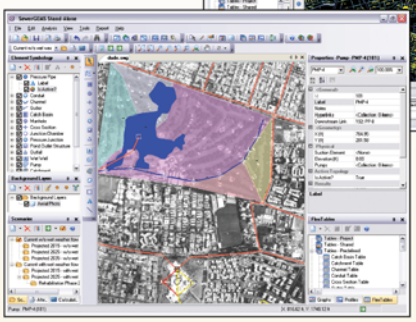


AutoCAD Interface



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Water is sent to all AWA members eight times a year. It is also available via subscription.

Water

OUR COVER: *Irrigation of commercial leaf vegetables by purified wastewater from Melbourne Water's Western Treatment Plant. However, this water is too salty for vegetables, so it is shandied with precious fresh water. City West Water, which services the western suburbs industrial zone, is helping industry to reduce the salt load (see papers pages 27 to 34). Success in this program may avert the need to desalinate in order to expand beneficial re-use.* ***Photo courtesy of Melbourne Water.***

POSITIONING FOR THE FUTURE

The Australian Water Association (AWA) will move to serve the broad mix of water practitioner and organisational needs across Australia, while still delivering tightly focused services for special interest groups, based on our recent strategic planning meeting. We will also continue to work on raising our profile and providing impartial, expert advice that informs debate about water. Engaging the community at large, to ensure that information about water is accessible and meaningful, will remain a key commitment.

I was very pleased at these outcomes from our second meeting between AWA's Board and its new Strategic Advisory Council, or SAC. Set up earlier this year as part of our governance reform, the SAC includes the diverse leadership of the Association, with two representatives from each Branch, plus one from the Water Services Association of Australia (our Sustaining Member) and IWA Australia.

The meeting we held on 11 November 2005 was important because it was focused on AWA's strategic direction and priorities. We used Martin Stewart-Weekes as an external facilitator and he created a challenging and stimulating atmosphere, which successfully elicited a range of exciting ideas. The meeting was also briefed on the outcomes of the recent online member survey, so it was grounded in feedback from members across the country.

Darryl Day, AWA President, at the November SAC meeting in Sydney.

An interesting feature of the meeting dynamics was that, although six different table groups put their thinking caps on, there were strong common threads running through the emerging ideas. Perhaps that is not too surprising, given the briefing and their shared passion for AWA's future; but it was encouraging, nonetheless, that such unanimity could be reached. I believe that bodes well for the delivery of activities locally by Branches and nationally by Special Interest Groups.

Water is a complex area, and our solutions for the future will require more integrated approaches to provide reliable water supplies whilst protecting public health and our environment.

In the discussions over that day, it was clear that members see the need for AWA to be a significant player in policy evolution; not through promoting any particular policy, but through provision of the necessary, dispassionate advice to decision makers and opinion leaders. Of course, that presupposes a willingness to listen to our views; a precondition that we have probably achieved among bureaucrats in Canberra, but not necessarily among politicians and in states and territories, although some Branches have established good profiles locally.

Water is a complex area, and our solutions for the future will require more integrated approaches to provide reliable water supplies whilst protecting public health and our environment. The strength of AWA has been in bringing together diverse parts of the water sector through expanding the scope of membership, working with allied associations and providing linkages between water practitioners in diverse fields. Australia is uniquely placed in our ability to foster integrated solutions, partly through our climatic challenges, but increasingly through the convergence in managing our water future. The National Water Commission, supported by strong political leadership, is unique in our history in having a national approach to water challenges that transcends political division and intergovernmental challenges.

The readership and influence of the weekly *Water News* continues to grow, with around 12,000 direct subscribers, reflected the expanding interest in water and the need for knowledge and networking on water issues. Our greatest challenge, as AWA grows, is the support for our Special Interest Groups which have the challenge of a national and international (via IWA) membership, and deliver activities at a local level. As our industry networking and collaboration expands, these Special Interest Groups will strengthen and deliver the depth of collaboration and knowledge sharing in focused areas.

Engaging a policy officer, located in Queensland to support our CEO, Chris Davis, will go a long way to enable this strategy; and I hope that, by the time this issue reaches members, an appointment will have been made. Building our profile also needs work and having Sue Corlette, our new Marketing and Communications Manager, on the team will be an enabler in that respect.

Community engagement remains a massive challenge, which lies at the feet of Corinne Cheeseman and the 1,200-strong Water Education Network. We had interesting discussions about how WEN might penetrate further and faster; but had to leave the ideas for others to germinate. The upcoming WEN Conference in Alice Springs, next April, will be a good forum for discussion on that topic.

Water security and our water environment are priorities for our community which has raised the political interest and commitment. Our strategic planning and AWA's focus are critical for the future of all involved in water, public health and the environment.

Darryl Day

water

FUTURE MAJOR FEATURES

FEBRUARY - Onsite Systems, Algal Toxins, E-water CRC Research Program

MARCH - Online Monitoring, Odour Management, Membrane Technology, Young Professionals

MAY - Enviro 2006, demand management - smart meters, innovation in stormwater, benchmarking

REUSE BREAKTHROUGH

Well, after an inordinately long wait, the draft *National Guidelines for Water Recycling* have finally been released for public comment, sub-titled *Managing Health and Environmental Risks.* At the time of writing, I'd not been able to work through more than a few of the document's massive 353 pages, but I welcome the publication and congratulate the authors on getting there.

Pragmatically, the draft is just phase 1, and neglects ASR (aquifer storage and recovery) and stormwater. It also tends to skate over indirect potable reuse. Phase 2, to follow, will include the missing sections, although many of the principles and methodology are generic and can embrace the other aspects right now.

The two urban water topics that are making most headlines around Australia are reuse and desalination, with reuse leading the field right now for poor and misleading information. Somehow, reuse has acquired a personal, emotive component absent from the desalination discussion. Instant experts and people with agendas pop up out of the woodwork and create more confusion and uncertainty, especially when indirect potable reuse is mooted.

world in creating a risk-based framework for designing and evaluating a water quality management system. The Australian Drinking Water Guidelines broke new ground in this area in the 2004 revision, and those principles have now been applied to reuse.

Using the unit of DALY (Daily Adjusted Life Years - 0 is normal, healthy life, while 1 is death), the Guidelines will enable practitioners to apply risk assessments to all facets of a reuse project and to ensure that no-one is exposed to an aggregate risk of more than a microDALY (10^{-6} DALY). Translating that risk level into more familiar territory, it is equivalent to one case of diarrhoeal infection per 1000 people annually (background infection rates in Australia are at this sort of level).

It is a brave step to quantify risk at all, since some stakeholders aim for zero risk in their sectors; which is intuitively attractive but unachievable. The risk-based approach is thus a real breakthrough and has the potential to remove much of the heat and emotion from future discussions.

Irrespective of the availability of scientifically sound guidelines, indirect potable reuse is going to be a controversial issue; it divides AWA members so it has even more potential to divide the community and decision makers. It is understandable that some jurisdictions have put indirect potable reuse into the too-hard basket, especially when their local circumstances don't demand that sort of option. Equally understandable, though, is the view of highly water-stressed communities, for whom indirect potable reuse seems to be a viable option.

Chris Davis

Ultimately, no solution can be rammed down the communal throat (literally or figuratively), so engagement is essential, leading to an informed consensus one way or the other. The draft Guidelines address the concept of community consultation, but it is a major discipline in its own right, so utilities wanting to go down that path will have to invest in the capacity to do it properly.

Societies seem to have a gestation period for new ideas; attempting implementation in less than that incubation period is asking for trouble; so we have to begin the dialogue and let the incubation begin. Part of the dialogue might need to be a demonstration site to generate real experiences and for people to 'kick the tyres'.

AWA will make a submission on the draft Guidelines, so input from readers will be useful to help us gauge reaction from stakeholders, but comments from people who are interested will be very helpful, on any aspect.

Please send comments and discussion to me by the end of December 2005 to cdavis@awa.asn.au. The Draft Guidelines can be found at http://www.ephc.gov.au/pdf/EPHC/Water/DraftGuidelines_Oct05.pdf

Chris Davis

For water businesses to move forward on reuse projects in a climate of suspicion and emotional reaction is counter-productive; so rational guidelines are essential to provide neutral ground for evaluation.

For water businesses to move forward on reuse projects in a climate of suspicion and emotional reaction is counter-productive; so rational guidelines are essential to provide neutral ground for evaluation. It seems that, once again, Australia will lead the

water
Contributions Wanted

Water journal welcomes the submission of papers equivalent to 3,000-4,000 words (allowing for graphics) relating to all areas of the water cycle and water business to be published in the journal. Topical stories of up to 2,000 words may also be accepted.

All submissions of papers intended for the main body of the journal should be emailed to the Technical Editor, bswinton@bigpond.net.au. Shorter news items should be emailed to news@awa.asn.au. A submitted paper will be tabled at a monthly Journal Committee meeting where, if appropriate, it will be assigned to referees. Their comments will be passed back to the principal author. If accepted and after any comments have been dealt with, the final paper can be emailed with the text in MS Word but with high resolution graphics (300 dpi tiff, jpg or eps files - Zip disks or CD-ROMs can be accepted) as separate files, or hard copy photos and graphics suitable for scanning by the publisher can be mailed to 23 Blaxland Rd, Wentworth Falls, NSW 2782.

Authors should be mindful that *Water Journal* is published in a 3 column 'magazine' format rather than the full-page format of Word documents. Graphics should be set up so that they will still be clearly legible when reduced to two-column size (about 12cm wide). Tables and figures need to be numbered with the appropriate reference in the text e.g. see Figure 1, not just placed in the text with a (see below) reference as they may end up anywhere on the page when typeset.

GARDEN AGRICULTURE: A REVOLUTION IN EFFICIENT WATER USE

By David Holmgren

Since Mollison and Holmgren published *Permaculture One* in 1978, permaculture has spread globally and is particularly popular in Australia. However, producing food at home has remained marginal to public debates and policy discussions about sustainable agriculture, water and other resource use. In fact, permaculture and related networks have barely succeeded in stemming the loss of garden agriculture that was once an integral aspect of our household and community economies and our urban landscapes.

The decline of garden agriculture in Australia and most affluent countries has been due to the ready availability of cheap fresh food, subsidised by cheap fossil fuel. The loss of food growing skills combined with urban in-fill policies that have destroyed some of the productive potential of our cities are also factors inhibiting the redevelopment of garden agriculture. Public policy blindness to the health and food security benefits of home food production is matched by ignorance of the potential gains in resource use efficiency and sustainability of garden and urban agriculture. This peculiar situation reflects a general public policy blindness towards household and community economies that might bypass corporate profits and government taxation.

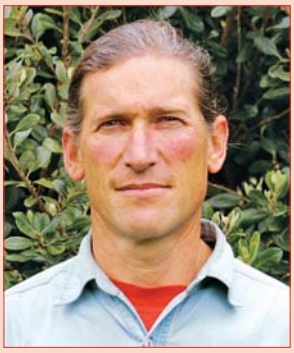
The imminent peak and then decline of cheap high quality fossil fuel energy will force radical changes in every aspect of the economy and society and will turn on their heads many of the assumptions of the mainstream sustainability debate.

An example of where this will shift the water debate concerns the linkage between urban and agricultural water use. Some commentators suggest that the debate about household water use efficiency misses the point that over 70% of our per capita water use is in agriculture. Even allowing for the proportion of agricultural produce exported to help generate income to buy our DVD players etc, the water required to produce our food dwarfs the 8% currently used in our households and gardens. The conclusion generally drawn is the need for more focus on agricultural water use efficiency.

However an equally valid conclusion of the "water for food" issue would be to look at the potential to convert the irrigated amenity landscapes of the suburbs (some of our largest irrigation districts) to garden and urban agriculture. By redesigning the food production and supply chain around garden agriculture and urban agriculture it may be possible to achieve huge gains in resource use efficiency. For example the Food Forest, a permaculture-designed farm on the fringe of Adelaide uses one fifth to one tenth the irrigation water of comparable conventional systems, and pays urban water rates to produce a diverse range of horticultural and small livestock products (including value added ones).

On tours of my own property, "Melliodora", I generally point out that our permaculture system provides the bulk of fruit and vegetables, processed and preserved food, dairy products, eggs and small livestock products for about 4-8 persons from less than a hectare. This same area of land is a living and working space for the residents and serves research and demonstration functions as well as providing a high level of ecosystem services including storm water harvesting and treatment. The majority of the 1 ML/annum water consumption is urban stormwater and the usage is a fraction of that used in conventional broad acre and market garden agriculture and includes everything used in processing, preparation and cooking. The conventional food supply chain also involves substantial additional use of water for these processes.

Suburban development and living have been roundly criticised over recent decades as unsustainable and alienating. Planning policies have favoured higher density and infill development to get better use of public infrastructure and to protect agricultural land. Battling to voice another side to the debate, permaculture activists have promoted an alternative set of strategies and techniques for retrofitting the suburbs for more self-reliant and sustainable living.



David Holmgren is best known as the co-originator (with Bill Mollison) of the permaculture concept. He is the Principal of Holmgren Design Services and lives at Melliodora, a permaculture demonstration site in Hepburn Springs, Central Victoria. Email: holmgren@mail.vic.chariot.net.au

Population density in Australian suburbs is no higher than the world's most densely populated agricultural regions. Storage and efficient use of rain collected from roofs in the densely populated coastal areas of Australia can provide for the majority of home uses, including gardening. This can be supplemented by treatment of greywater (from the bathroom, laundry, and kitchen) through gravel reed beds for subsequent use in the garden. Also, blackwater (from the toilet) can be treated and re-used on site in some circumstances. Alternatively, the installation of waterless composting toilets ensures water goes to more productive uses and closes the nutrient cycle from human waste to fertile food producing soil, a critical factor in the sustainability of urban settlements.

Guy Parker Award

This Award is made to honour the memory of Cecil David (Guy) Parker, the foundation chairman of the Journal *Water*.

The winner of the best paper published in *Water* between June 2004 and May 2005 was "Risk Management and Due Diligence in the Water Industry", by Annette Davison & Daniel Deere - published in Volume 32, No 3, May 2005.

The Award carries a prize of $500.

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Of course to expect such fundamental redesign of our food system just because climate change and the future energy crisis is threatening to amplify our current problems with water resources may still be politically and socially unrealistic but it is frustrating that current propaganda from governments, water authorities and even environmental organisations advocates only decorative gardens of hardy natives because they use minimal water. Instead we could be maximising the opportunities to use reticulated and storm water, efficiently, for urban food production.

It is very difficult to get serious discussion about sustainable resource use and settlement design at present, not just because most participants unconsciously accept cheap energy and stable climate regimes as given. The lack of whole system modelling and appropriate statistics combined with blindness to the potential power and efficiency of the household and community (non-monetary) economies all restrict the debate to refinement rather than fundamental redesign for a future of energy descent and erratic climate.

Over the next two decades, the costs of the current energy-intensive and long distance food supply systems will probably force this reorganisation anyway. Whether this happens by ad hoc on-farm and household response to rising costs and/or by pro-active land use planning, economic and social polices, such as those implemented in Cuba in the 1990s with the collapse of its energy subsidy by the Soviet Union, remains to be seen.

Permaculture continues to evolve as both a conceptual framework and practical strategies for creative personal, household and community response to the energy descent future. Garden agriculture is just one application of permaculture principles, but one that has the potential to reshape how we think about the balance between agricultural and urban water use.

For further information visit www.holmgren.com.au/html/Publications or the book *Permaculture: Principles and Pathways Beyond Sustainability 2002.*

Aquaphemera

Engineers Australia recently published their *Infrastructure Report Card* (www.infrastructurereportcard.org.au). It covers roads, rail, electricity, gas, airports, potable water, "wastewater", stormwater, irrigation, ports and telecommunications. The general objective of the *Report Card* is to rate the quality of the infrastructure, ratings being based on asset condition, availability and reliability, management sustainability (including economic, environmental and social issues) and security. The *Report Card* is an excellent initiative of Engineers Australia and is a very useful tool in determining how we are progressing and in raising awareness of the state of our infrastructure.

Nationally, Potable water rated a B- up from a C in 2001. This was based on recognition of the increased investment in renewing pipe networks, improved treatment and reduced water loss systems. "Wastewater" C+ up from a C- due to increased investment including rehabilitation of existing infrastructure and improved treatment. Stormwater C- up from a D, but only marginally. Irrigation C- up from a D-, but infrastructure is considered largely inadequate, insufficient and unsustainable.

The report emphasises the need for sustainability; defining appropriate levels of service and strategic planning. However, despite nearly all sectors improving in the last 4 years, the Report Card continues to call for more funding without identifying where it will come from and even seeming to bemoan private industry involvement. The Report Card also recommends setting up a national bureaucracy to advise the sectors, but to not interfere! Rather, the focus should be on encouraging private sector involvement to improve our infrastructure, as they have the funds and are ready to assist; while Governments ensure that what the private sector provide, meets our required levels of service nationally and is sustainable. The infrastructure report card, if it is done rigorously and consistently across sectors and States, can be the corner stone in setting directions and standards across Australia for our vital infrastructure.

- Ross Knee

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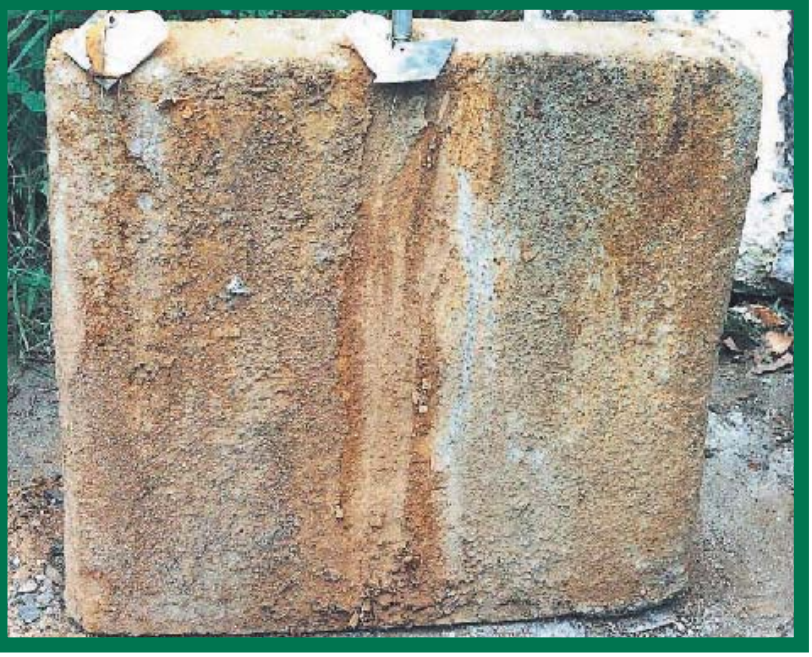

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2005 AWA MEMBER AND STAKEHOLDER SURVEY

The following report provides the initial results from the recent AWA survey. This information was used to help inform the recent AWA strategic review process and will be further analysed and cross referenced to help us create a more relevant organisation for the future.

Introduction

Complete Surveys: 523
Partial Surveys: 121
Non member responses: 175 (3.5% of pool)
Member responses: 493 (12% of membership)

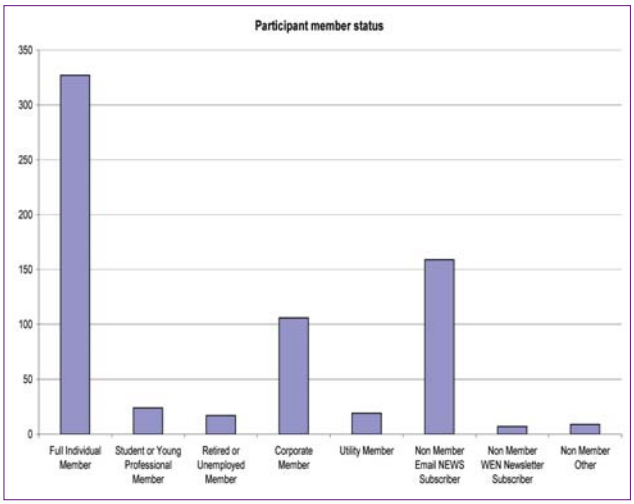
Limitations

The most obvious shortcoming of this survey was the failure to capture branch/state demographic information to help identify regional issues and bias and we will need to ensure we make these linkages next time to see if there are any strong regional differences.

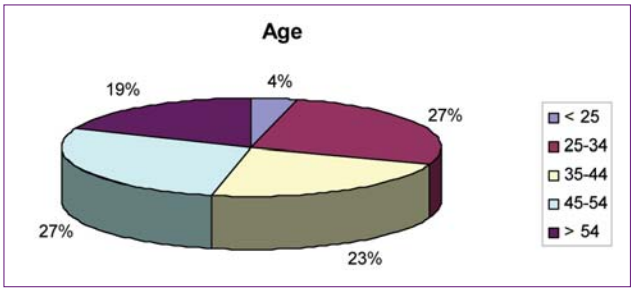
With only 12% of members responding there is an element of non-response bias and whilst 500 plus respondents is a good sample it is important to keep this in perspective when extrapolating the results to industry wide implications.

Section 1. Respondent demographic summary

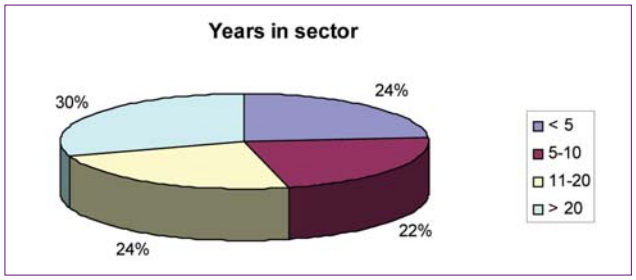
1. Member and stakeholder information



2. Age



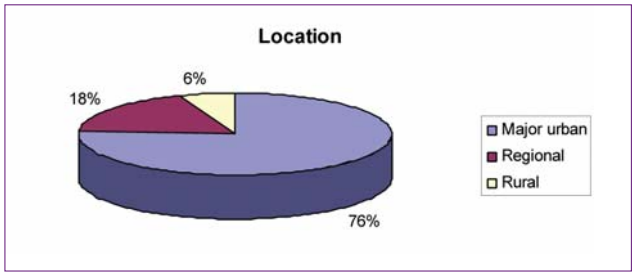
3. Number of years in water sector



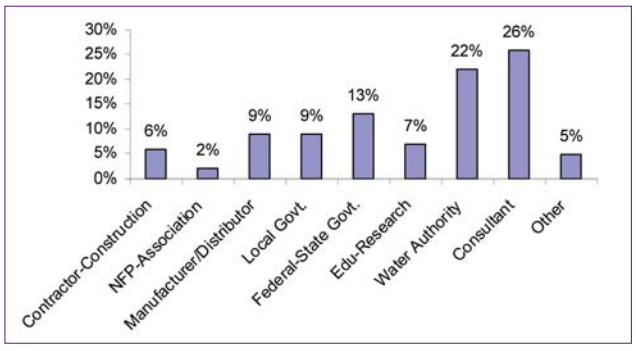
4. Gender

2005: 29% female 71% male

5. Location



6. Area of employment or business



7. How many events have you attended in the past 12 months?

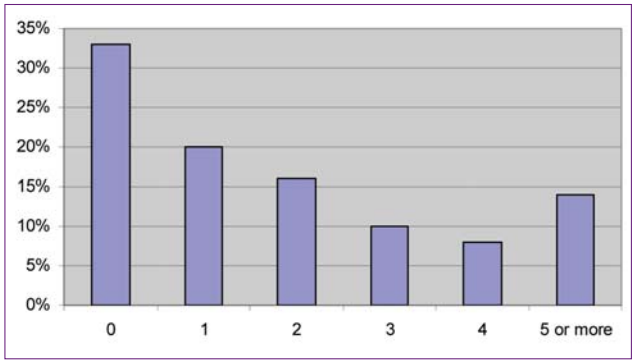


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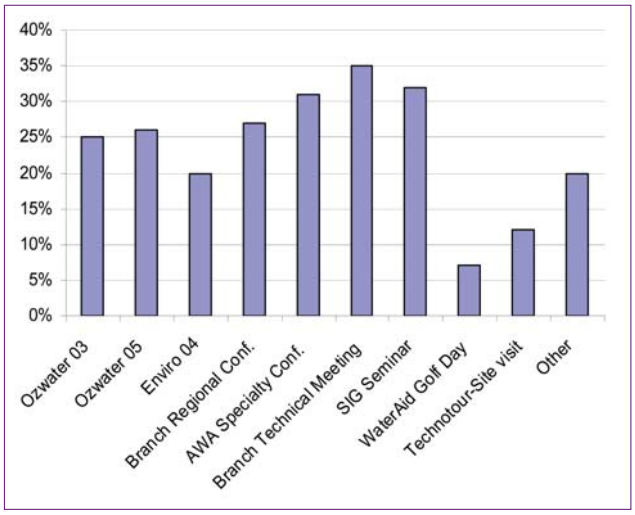
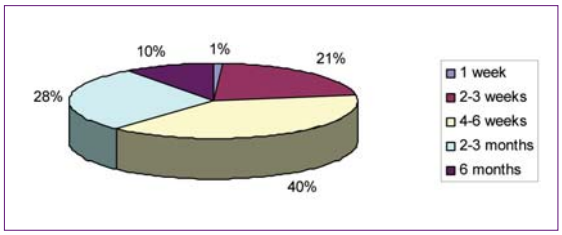
ABB

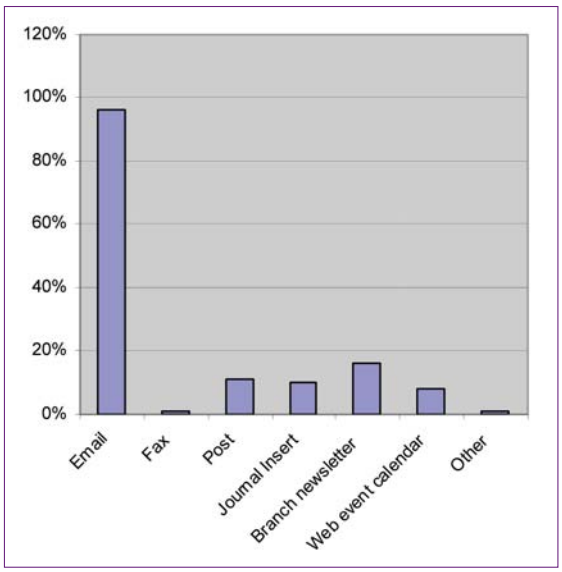
8. Which events have you attended in the past few years?



9. How far in advance of an event do you prefer to receive information?



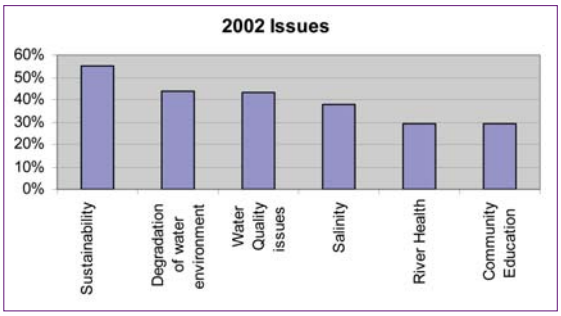
10. What are your preferred forms of communication about up coming events?



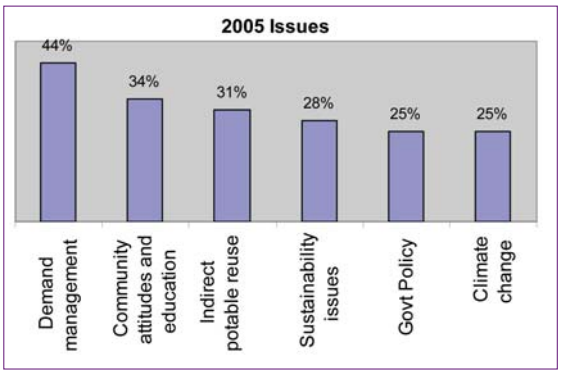
Section 2. Water Industry Issues

11. In striving for a more sustainable water future, Australia will face many challenges. From your experience and expectations please rate how critical concentrated effort in the following areas will be over the next few years.

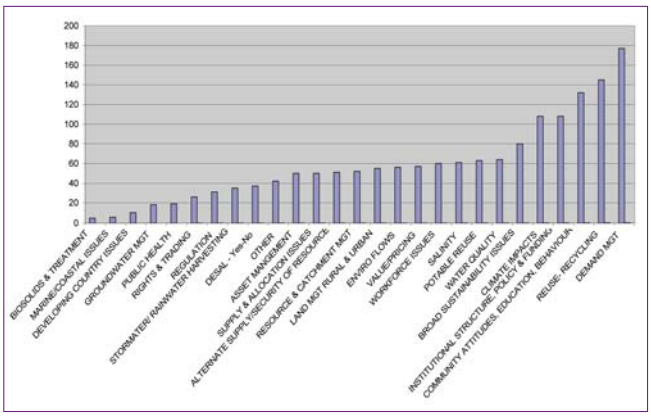
In 2002 the issues rated as most critically important (rated 5) were identified as:



In 2005 the issues rated as most critically important (rated 5) were identified as:



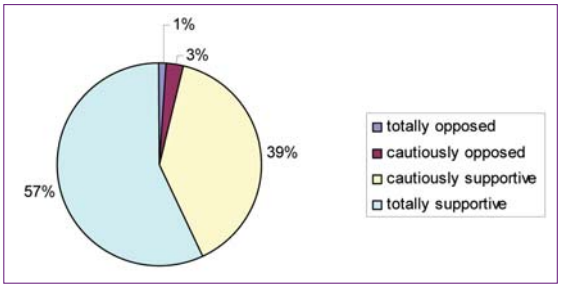
12. In the next 3 to 5 years, what do you think will be the three most important challenges facing the water industry as a whole?



According to the results the three most important challenges facing the industry over the next 3 to 5 years will be:

- Demand management
- Re-use - Re-cycling
- Community education, attitudes and behaviour change

13. How much do you support AWA developing and publicly commenting on water issues and policies?



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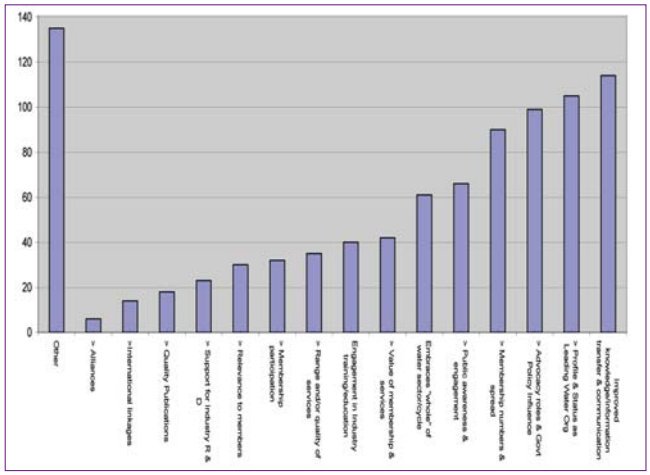
Section 3. AWA's Future Direction

14. In the next 3 to 5 years, what do you think will be the three most important challenges facing AWA as an organisation?

Of the 384 free text responses the following represented the major challenges for AWA:

- Policy input and outcomes
- Maintaining relevance - adapting to change
- Membership recruitment
- Community engagement
- Advocacy, leadership & representation

15. What do you think will be the three most important results AWA has to achieve over the next few years that will demonstrate it has been successful from your perspective as and AWA member/stakeholder?



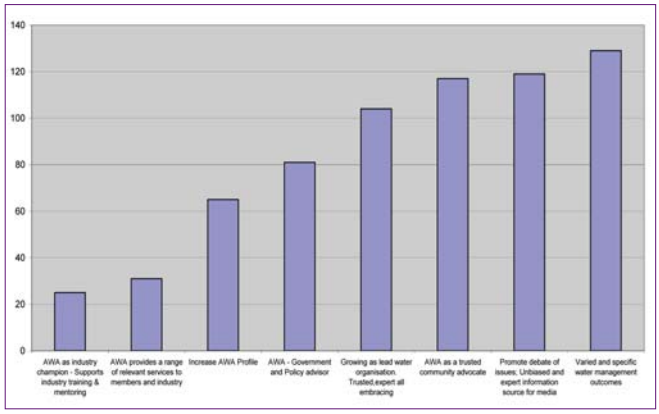
The 360 responses were grouped with the key outcomes identified as:

- Improved knowledge/information transfer (communication)
- Improved profile and status
- Increased advocacy and policy role
- Increased membership numbers and industry spread
- Increased public engagement and community awareness

In 2002 the post important outcomes were:

- Increase public profile on water issues
- Increase advocacy-lobby functions
- Improve information transfer through seminars and events

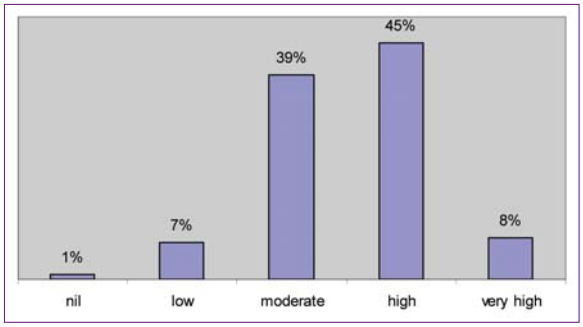
16. What do you think will be the three most important results that AWA has to achieve over the next few years that will demonstrate that it has been successful from the perspective of the wider community and water industry?



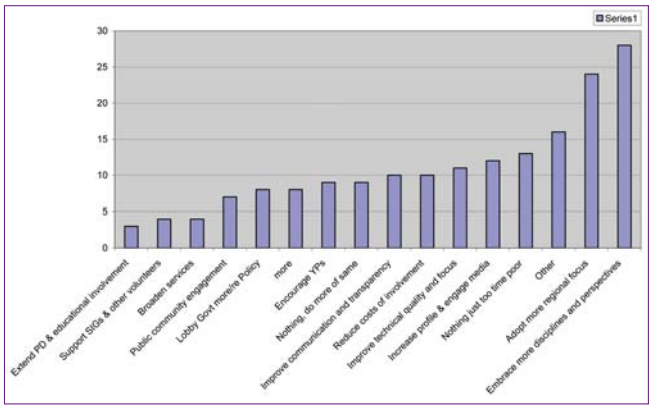
17. Over the past two years AWA has strived to raise its profile through the media and other involvement in the public arena. Do you feel these efforts have been successful?

YES: 56% NO: 44%

18. As a member or stakeholder how would you rate your level of commitment and pride in being associated with AWA?



19. If you rated your commitment less than 4, what do you think AWA needs to do to encourage your greater engagement with our programmes and services and the organisation more generally?



The top two responses are:

- Embrace more disciplines and perspectives
- Adopt more regional focus

AWA has been implementing some important changes to its structure and governance over the past twelve months. From your perspective, have the changes:

20. improved AWA's responsiveness to members?

YES: 26% NO: 9% Don't Know: 65%

21. improved AWA's leadership and management?

YES: 23% NO: 7% Don't Know: 70%

22. made the organisation more efficient and streamlined?

YES: 19% NO: 7% Don't Know: 74%

23. created any problems or negative outcomes?

YES: 8% NO: 27% Don't Know: 65%

UPDATE FROM THE WATER EDUCATION NETWORK

Corinne Cheeseman, Education Program Manager, AWA

In this last issue for the year I would like to take this opportunity to thank those that have made contributions and supported the WEN during 2005. Many people from across the country have contributed by writing stories and sending information for inclusion in WEN e-news; hosting, speaking and attending WEN Network Meetings and generally keeping in touch with me to that ensure make sure I am across the initiatives and programs they are working on. The strength of the network is certainly in the people who contribute to it.

I have also received many inquiries in my role and I am now familiar with the various education initiatives and programs across the country to be of assistance. In 2007, I hope to be able to capture this information on resources, databases, programs and courses in the form of an online searchable database (or series of databases) so that everyone can benefit.

I would also like to make special mention of the conference organising committee for next year's water education conference, 'From the Waters Edge to the Red Centre' which will be held in Alice Springs. The committee's assistance in developing the conference themes, program and reviewing the submitted abstracts has been extremely valuable and it is a pleasure to work with such an enthusiastic committee.

From the Waters Edge to the Red Centre - Registrations are now open - see the included brochure for all the details! It is shaping up to be a huge conference with more than double the number of abstracts submitted by comparison to the 2004 education conference. If you are involved in water education - this conference should not be missed!

Water Industry Training and Professional Development

Those involved in professional development and training in the water industry will be pleased to hear that AWA's Board recently agreed to engage a contractor to start work on the outcomes of the Water Industry Training Forum held in Sydney in May this year. As a result, I am currently working with Carla Scomazzan and Joan Whelan of Australian Local Government Training (ALGT) to develop a plan and timeframe for these actions. Work is likely to commence on this project in early 2007.

A training stream is included in the draft program at next year's Water Education Conference. Invited speakers are currently being confirmed and details will be available on the website as this information comes to hand.

Australian Junior Water Prize

The Australian Junior Water Prize (AJWP) competition structure has been redesigned so that we are able to capture the best student water science projects from across the country. The new look information kit, which contains revised international selection criteria, is now available at www.awa.asn.au/ajwp.

In 2006 the national AJWP awards ceremony will be held at the Water Education Conference. This will provide the opportunity for the WEN to be a part of the awards ceremony and find out more about this prestigious award. If you would like to assist in providing information to schools through your current links and relationships please contact me at ccheeseman@awa.asn.au.

National Water Week

National Water Week was celebrated across the country with a diverse range of activities, forums and events held during the week of 16-22 October. The week also provided increased media profile around water and encouraged community involvement in water related activities and events locally. AWA supported National Water Week through various channels including media releases and interviews; promotional merchandise and collating a national event list which was available to the public on the web.

Support for National Water Week from AWA's Branches at the recent strategic meeting resulted in the Board approving funding to boost the profile of the week. This is an exciting initiative and will provide the resources required for AWA to take the role of national coordinator from 2006.

National Water Week will be held from 15-21 October in 2006 and planning is now underway. A national coordinating committee will be convened with representatives in each state at the Water Education Conference in April 2006. Further details will be available following the outcomes of the April meeting.

YOUNG WATER PROFESSIONALS - *NURTURING THE NEXT GENERATION IN WATER*

Chris Corr - Chair, National Representative Committee, AWA Young Water Professionals

As the year draws to a close it has been a highly successful one for the Young Water Professionals. YWP has continued to expand and consolidate the network and services. During the year YWP commenced a regular column in AWA's publication Water and have provided contributions to the last four editions. The feedback and support received from this source has been fantastic and very rewarding. The state and

territory branches have continued to strengthen with some form of YWP committee and representation now present throughout Australia and also into New Zealand.

1st Joint AWA/IWA Young Water Professionals Conference, Sydney 15-17 February 2006

2006 promises to be a big year for the YWPs. Some very exciting activities will be undertaken throughout Australia by the different groups. Notably the Young Water Professionals Conference which will take place in Sydney. The sourcing of a large amount of sponsorship and the use of cost effective venues and accommodation will see the costs kept to a very reasonable level to enable the maximum number of YWPs from around Australia to attend. Registration will soon be available for the conference. Further information visit: www.cwwt.unsw.edu.au/ywp2006.html

The YWP Conference will the launch of the AWA YWP Mentoring program. This program is being developed for both the conference and for future roll out throughout AWA. A large amount of input into this is coming from some great work being done by the QLD YWPs as well as our board representative Christobel Ferguson. For more information email cferguson@ecowise.com.au. Needless to say the conference should be a wonderful kick off event.

YWP Membership Category

The creation of the new AWA YWP Membership Category during the year has also been very well received. The initiative supported and approved by the AWA Board enables younger workers within the water industry to pay a reduced AWA Membership fee for the first 3 years starting from $55 (incl GST) in the first year and rising to the full Member rate in the 4th year. In June 2005 there was only one YWP Member, however with the initiative gaining momentum, the uptake in recent months has increased considerably now standing at 53 in November 2006. This is a great initiative for younger people to get involved with Australia's largest water industry association at a very reasonable price. Further details are available at AWA's web site. If you are eligible and have not yet joined up then what are you waiting for? Visit the website: www.awa.asn.au/sigs/ywp.

Some fantastic YWP events have been run in different parts of the country. Some groups have been holding their own events whilst others have been combining efforts with other similar young professional groups. Victoria also recently organised a regional YWP Event to Bendigo which took place over a Friday afternoon/evening and the following Saturday. Keeping the costs down through sourcing valuable sponsorship. Further reports will follow on the success of this event which aimed to assist with fulfilling one of AWA's key aims to serve the regional areas.

We hope that all young professionals working in, or aspiring to work in, the water industry have had an enjoyable and productive year and we look forward to seeing you and working with you in 2006.

Please talk to us, join with us, and together we can nurture the future of Water.

WATERAID AUSTRALIA UPDATE

Chris Wootton

Yarra Valley Water in Melbourne has become the first water authority in Australia to insert a WaterAid Australia leaflet seeking donations from their customers. The leaflet is being distributed with their quarterly accounts during October/November to over 665,000 customers. WaterAid would like to acknowledge the support of Yarra Valley Water for their leadership and invite other members around Australia to consider placing an insert with their accounts.

On-site in Timor-Leste

WaterAid Australia welcomes Dinesh Bajracharya - who commenced a month-long orientation program in Timor-Leste. He will formally commence duties providing water and sanitation expertise as part of the Plan - WAA program in Ailieu District from January next year. Dinesh comes to us with extensive experience with WaterAid Nepal and NEWAH.

Sydney Yacht Regatta - 17 March 2006

WaterAid Australia's next major fundraising event in Sydney will be held on the Harbour as part of a Corporate Regatta - sailing from the Cruising Yacht Club of Australia at Rushcutters Bay. The Working Group is currently seeking sponsors for this event and information on how to book a yacht will be available early in the New Year.

For more information, go to www.wateraid.org.au

Golf Day 2006

The 3rd Annual National Golf Day for WaterAid Australia, will be run in various locations around Australia. The Golf Days will be held to coincide with World Water Week running from 20-24 March 2006.

Our aim for 2006 is to raise more money for WaterAid. All funds raised from the golf days will go towards a WaterAid Projects that will provide safe drinking water, sanitation and health education to rural communities and primary schools.

Sydney is the first state to confirm their golf day will be on the 21 March at Muirfield Golf Club.

We are thankful to Vinidex who will be our national sponsor once again for 2006.

We welcome your support and donations in March 2006. We encourage all water industry personnel and golf enthusiasts to continue to have fun while helping us build a strong and successful annual event for WaterAid Australia.

Enquires to Errin Dryden on 02 9413 1288 or edryden@awa.asn.au

Keep an eye out for the updates on the AWA website. More details to follow in the February edition of *Water*.

AWA RAPPORT WITH NEW SINGAPORE ASSOCIATION

AWA President Darryl Day recently visited Singapore and met with leaders of the newly formed Singapore Water Association (SWA). Darryl and SWA President Olivia Lum discussed a memorandum of agreement, which has since been ratified by both organisations, ensuring close liaison for the future.

SWA is an industry association, admitting, at this stage, only corporate members, of which there are around 85 so far. The water scene in Singapore is very lively, with desalination, recycling and water harvesting projects going strong. An Australian delegation visited all the key installations there in February this year, as a TECHNOtour. A Singaporean keynote speaker featured in the WSAA stream of Ozwater in Brisbane in May.

To encourage the concept of not-for-profit activity in Singapore, AWA already has an interim arrangement with Florence Yeo of Tick 3 to recruit and service local members, at a favourable rate. In total, 39 members have signed up through that route and, in the fullness of time, we envisage that those members could become the core of individual membership for SWA.

ASPIRE 2007

Sponsorship and exhibition opportunities are available for the IWA Asia Pacific Regional Group (ASPIRE) Conference and Exhibition in Perth, 2007.

The prospectus can be downloaded from www.awa.asn.au/events/aspire.

This will be the second ASPIRE conference held, with the first taking place in Singapore in July this year. Singapore was attended by over 600 delegates from over 36 countries consisting of engineers, practitioners, academics and scientists from the water industry in the Asia-Pacific region.

For further information on sponsorship and exhibition opportunities, please contact Linda Phillips on 61 2 9413 1288 or aspire@awa.asn.au.

MASTER CLASS I FOR 2006 "THE PRICE OF WATER"

March 2 and 3, 2006
KPMG, King Street Wharf, 10 Shelley Street, Sydney

Following the successes of our 2005 Master Classes - Water and the Law (March) and Water Systems Security Management (November), AWA is offering another two day, small group intensive Master Class. Pricing is a somewhat testy area where public policy, economics, supply-demand issues, rural and regional priorities are forced to search for compromises.

The speakers for this Master Class come from a diversity of professional and philosophical backgrounds: Glenn Maguire from KPMG, Simon Fane from the Institute of Sustainable Futures, Mark Bartley, Partner at Phillips Fox, Doug Miell from NSW Irrigators Council, Professor Andrew Worthington from Wollongong University, and Gary Stoneham, Chair of the Working Party on the Market Based Instruments Program (National Action Plan on Salinity & Water Quality) in Victoria. Their expertise is complimented by that of Chris Davis, AWA's CEO and Claude Piccini from WSAA. Both of these two gents have made water pricing a special issue of concern and spoken publicly on the subject for Australian consumers and the industry.

The very detailed program has been uploaded to the Master Class website at www.awa.asn.au/events. A registration form is also available there for download. We expect this Class to fill quickly so and numbers are strictly limited. If interested, you are encouraged to register early. KPMG are hosting this event at their new Sydney Headquarters including the drinks/dinner programmed for the evening of Day 1. *Enquiries dwiesner@awa.asn.au*

ONE DAY AWA SEMINARS ON SEDIMENT WATER QUALITY ASSESSMENT

Most people who live near a waterway, visit a recreational area for swimming, camping and fishing or just enjoy the peace of river and lake scenery, rarely think about what's going on in the muddy bottom and whether or not the sediments are as clean and free of contaminants as the surface water may appear. Learning about assessing the quality of sediments is an area which has been slow to gain traction with the general water industry. However, times are a changing especially as increasing attention is paid to the impact of industrial residues & human contaminants on susceptible species such as our fragile wild life.

Water quality scientists, planners, environmental professionals & catchment officers need to become skilled in identifying changes in species behaviour and learn the skills for proper collection & analysis of data occurring in the sediment layer. The 2006 AWA Seminars series on Sediment Water Quality Assessment in February provides that opportunity. The speakers for this event - including Graeme Batley, Stuart Simpson, John Chapman and Anupama Kumar - are among those who contributed their scientific knowledge and expertise to the development of the National Water Quality Guidelines, are a fundamental tool for environmental and water quality assessment. The Program is designed to deliver these skills in a balanced manner.

The dates - February 15 (NSW) and 23 (Victoria) plus March 15 (SA) - will come around quicker than you think, especially with Christmas intervening. Registration forms for download are accessible from the website http://www.awa.asn.au/events/

LOOKING AHEAD

Planning has begun for the AWA Membrane Specialty Conference II in Adelaide in early 2007. Membrane Bioreactor Technologies and their applications will be a central plank to the conference program. An insight into the content of the conference can be gleaned from the following communication received from one of the European based committee members.

Promotion of Novel Waste Water Technologies by the EU 6 Mio € EU-Funding for Development of Membrane Bioreactor Technology

The European Commission has decided to boost the development and application of European membrane bioreactor processes for municipal wastewater treatment through financing two projects within the scope of its 6th Framework Program. The two consortia gather 25 European universities, research centres, enterprises and MBR plant operators. Furthermore two Australian universities and one South-African university are involved. The global project envelop totals to around 12 Mio € of which the European Commission's contribution to the projects amounts to 6 Mio € and of the Australian government to approximately 0.5 Mio €.

The projects "AMEDEUS" and "EUROMBRA" start in October 2005 and are scheduled for 3 years. They focus on research and development of the membrane activated sludge technology. This recent invention, commonly referred to as membrane bioreactor (MBR), is already implemented worldwide on a large scale to treat industrial wastewater, and is considered as a key technology to achieve advanced municipal wastewater purification in the future. Compared to conventional technologies, the MBR enables complete disinfection of the treated water, and may lead to superior elimination of trace substances and emerging pollutants.

Contacts for further information: www. kompetenz-wasser.de. Boris Lesjean, Project Coordination AMEDEUS boris.lesjean@kompetenz-wasser. de KompetenzZentrum Wasser Berlin gGmbH Cicerostr. 24, D-10709 Berlin www.kompetenz-wasser.de; TorOve Leiknes, Project Co-ordination EUROMBRA torove.leiknes@ntnu.no, Dep. of Hydraulic and Environmental Engineering Norwegian University of Science and Technology N-7491 Trondheim, Norway, www.ntnu.no/indexe.php www.ivt.ntnu.no/ivm/english/

How do I register for an AWA Event?

All AWA events and related events are listed on the online event calendar at www.awa.asn.au/events. This calendar provides a brief description of each event with a link to the event's own website and online registration, if available. All events have a hardcopy registration form which can be downloaded from the events website. Detailed information on state branch events can be found in the Branches section of the AWA website.

Points to note when registering:

- All AWA events have a discounted registration fee for AWA members. Corporate members may nominate one staff member to register at the member rate;
- Early registration is encouraged and appreciated. This assists with confirming final numbers with venues and suppliers and minimises the risk of cancellation. Most AWA events offer a discount for early registration;
- Online registration requires payment by credit card. Bankcard, MasterCard and Visa is accepted.
- If you require an invoice for cheque payment, please quote a purchase order number on your hardcopy registration form.

Featuring selected highlights from the AWA Email News

The AWA Board and SAC undertook an organisational strategic review in late October and almost 500 members and non-members responded - a great help to AWA officers in trying to develop policy and deliver services to members.

NATIONAL

Despite fewer farms IRRIGATING in 2003-04 than the previous year, slightly more water was used over a larger area, according to a report released by the Australian Bureau of Statistics (ABS). A total of 40,400 farms irrigated in 2003-04, down 8% from 2002-03. This figure represented under one-third (31%) of Australian farms, down from 33% in 2002-03. http://www.abs.gov.au/ausstats/abs@.nsf/7884593a92027766ca2568b5007b8617/3ca24653809 23ea4ca256fd400779fdc!Open Document

NHMRC GUIDELINES for MANAGING RISKS IN RECREATIONAL WATER can be downloaded from the NHMRC web site. Part 1 (Chapters 1 & 2) provides a general overview for managers including key recommendations and Part 2 (Chapters 3-10) which provide detailed information on potential hazards associated with recreational waters. http://www7.health.gov.au/nhmrc/publications/synopses/eh38.htm

The Environment Protection & Heritage Council and the Natural Resource Management Ministerial Council are seeking public comments on draft NATIONAL GUIDELINES for WATER RECYCLING. The document and relevant material can be downloaded http://www.ephc.gov.au/ephc/water_recycling.html. Public consultation will be complemented by a series of public meetings in the capital city of each state.

DEPARTMENT OF ENVIRONMENT & HERITAGE, (Australian Government) announced a major research funding initiative, the COMMONWEALTH ENVIRONMENTAL RESEARCH FACILITIES (CERF); a total of $60m over four years for public good environmental research. Four priority areas, with WATER as a factor. Expressions of interest were due by 28 October and a short list will be available shortly for further work. http://www.deh.gov.au/programs/cerf/

A new DEPARTMENT OF WATER will be established In WA, consolidating all water-related functions and activities under the Premier. The new Department is expected to be operational by December 1 and it will play an integral role in developing a comprehensive legislative program to streamline and modernise an unwieldy catalogue of 14 extant Water Acts. http://www.wa.alp.org.au/media/1005/20004720.html

Long-awaited GUIDELINES for MANAGING RISKS IN RECREATIONAL WATER are now available on the NHMRC web site. http://www7.health.gov.au/nhmrc/publications/synopses/eh38.htm

Guidelines for Evaluating the Financial, Ecological and Social Aspects of Urban Stormwater Management Measures to Improve Waterway Health are now available on the CRC for Catchment Hydrology's web site http://www.catchment.crc.org.au - in the publications area.

A new Reference Group is to be appointed to advise on the future of the Australian

Government's $3.5 billion natural resource management programmes - the Natural Heritage Trust and the National Action Plan for Salinity & Water Quality. http://www.deh.gov.au/minister/env/2005/mr13oct405.html

The NSW Farmers' Association has supported Agriculture Minister McGauran's comments on drought recovery following a CSIRO report that claims government help is doing more harm than good by keeping uneconomic farmers on the land to the detriment of all, especially the most productive. http://fw.farmonline.com.au/news_daily.asp?ag_id=29941&

INDUSTRY

ABS Water Survey out now

The Australian Bureau of Statistics (ABS) is embarking on an annual collection of water statistics relating to the water supply industry. To facilitate this, the ABS dispatched a survey form to all water suppliers across Australia on 15 November. The survey collects information on the amount of water extracted, supplied and discharged by the water supply, sewerage and drainage industry during 2004-05. The survey results will be published towards the end of 2006, and the data will form a key input for the 2004-05 Water Account, Australia, which will be published in May 2007. The information will be nationally consistent, and will assist planners and policy makers at all levels of government and the private sector. The ABS appreciates the cooperation of survey respondents to return the survey form by the due date, and emphasises that the data supplied will remain confidential to the ABS.

WSAA has released a position paper on 'TESTING the WATER: URBAN WATER USAGE in our GROWING CITIES - the RISKS, CHALLENGES INNOVATION and PLANNING'. It is available as a free download on the WSAA website https://www.wsaa.asn.au/frameset2.html via their bookshop menu.

Consortia tendering for the contract to build Sydney's DESALINATION plant will build & operate two small pilot plants trialing their rival technologies in order to "create competitive tension so [they] have an incentive to come up with the best deal" http://www.smh.com.au/news/national/scully-dips-a-toe-into-the-water-with-kurnell-test-plants/2005/10/31/1130720481810.html. As well, SYDNEY WATER has set aside $94 million to buy land at Kurnell on which to build the $2 billion plant, and to finance the construction of intake and output pipes for the pilot plants estimated at about $5 million. Residents have seen water bills increase by 9% this year to help fund costs of the plant & ration supplies of water. Graphic http://www.smh.com.au/media/2005/10/31/1130720482943.html

MWH Australia has acquired Perth-based LIQUID EARTH, an independent consultancy, formed in 1998 & specialising in provision of hydro-geological advice to mining & industrial clients in Australia & Central Asia. DOUG BROWN, the current Manager, will continue in this role. Emma.Reiners@mwhglobal.com

Water is being released to inundate the BARMAH-MILLEWA FOREST, improve redgum health and flush out the wetlands. MDBC Chairman Peter McGauran, MP noted that it has been five years since the forest experienced a flood. http://www.thelivingmurray.mdbc.gov.au/

Kogarah Council & Sydney Water have launched a PILOT WATER RECYCLING scheme which will be trialed over 12 weeks & will see wastewater recycled for use on the Beverley Park Golf Club, the project first for Sydney. http://www.sydneywater.com.au/WhoWeAre/MediaCentre/MediaView.cfm?ID=293

Daryl McGregor, Chairman of NSW Water Directorate (left), and Chris Davis, AWA CEO, signing an MOU at the AWA Regional Conference in Dubbo, on 18 November.

INTERNATIONAL

The American Water Works Association (AWWA) with which AWA is affiliated, has won top honours for best non-profit advocacy campaign for its efforts to prevent drinking water utilities, local communities, & consumers with being saddled an estimated $25-$29 billion in cleanup costs for groundwater contamination arising from MTBE addition to gasoline rather than the energy companies who were responsible. http://www.awwa.org/advocacy/pressroom/pr/?ArticleID=515

The annual WATER SURVEY by NUS Consulting Group found the average price of water in USA rose 3.5% for the period July 1, 2004 to July 1, 2005. The survey covered data from 51 water systems across the country. The highest price paid for water was US$5.49per MGal, the lowest price US$0.80per MGal.: average cost was US$2.34 per MGal. including sewer related costs. http://www.wef.org/CmsWEF/Pages/News/StoryPage.aspx?story_id=84205070&ID=wef&Section=Industry%20News

To reduce the toxic effect of washing powder SURFACTANTS in surface waters & the burden they impose on wastewater treatment plants, 5 different EU directives from 1970s already ensure that detergents are biodegradable. From 8 October, a new Regulation introduces stricter testing methods. http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/05/1236&format=HTML&aged=0&language=EN&guiLanguage=en

Ireland has launched a public consultation on ways to prevent watercourses becoming polluted with NITRATES from agricultural run-off with emphasis on managing livestock manures & other fertilisers, primary sources of nitrate pollution. http://www.edie.net/news/news_story.asp?id=10633&channel=4

Researchers in US have developed a new tool to measure microbes' exposure to ULTRAVIOLET light used for DRINKING WATER DISINFECTION. Its "microsphere dosimeter" technique is the first direct test of how much UV light micro-organisms in fluids have been exposed to - important in validating the use of UV for improving the safety of tap water. http://www.eurekalert.org/pub_releases/2005-11/du-umt110105.php

Research team from Harvard University found that imminent CLIMATE

CHANGES in EUROPE will hit Mediterranean countries & mountain regions the hardest. The scientists predicted that the Mediterranean would suffer from increased drought, bringing with it water shortages & more wildfires. In mountain regions, warming would melt snow sooner & change runoff patterns, increasing the probabilities of spring flooding. http://news.bbc.co.uk/1/hi/sci/tech/4381960.stm

PEOPLE IN THE NEWS

Prof DON BURSILL Winner of the 1st Premiers Medal at the AWA South Australian Water Awards Dinner. On Friday the 21st of October, judges were unanimous in their decision to recommend Professor Don Bursill, Chief Scientist, AWQC, SA Water and CEO of the CRC for Water Quality and Treatment, as a very worthy recipient of the inaugural Premiers Medal for outstanding individual achievement in the water industry.

DR DAVID GARMAN has been elected as the first ever Australian President of the INTERNATIONAL WATER ASSOCIATION and will take office during the 2006 IWA Congress in Beijing. DR. ZHIGUO YUAN of the University of Queensland has replaced Prof. Changwon Kim as the chair of the Instrumentation, Control and Automation specialist group of IWA.

MARK PASCOE has been elected as President of the Australian Water Partnership (AWP) which is the local node in the Global Water Partnership. Mark took over from COL CREIGHTON, who had served as the inaugural President.

JIM BLOOMQUIST has been appointed as MD of CH2M HILL Australia Pty Ltd. Jim has over 30 years experience in the industry and 25 years with CH2M HILL. http://www.ch2m.com (look for Australia under the 'locations' button).

IAN CHASE is now Regional Sales Manager of the Environment & Process Division of Andritz Pty Ltd., a leading supplier of solid-liquid separation equipment, sludge dewatering & drying technologies. GEOFF MABBETT has been appointed the first Chief Executive Office of Sustainability Victoria which brings together Ecocycle & Sustainability Energy Australia of Victoria and which commenced operation 1 October 2005.

NICK CROSLING is the acting CEO of the newly created GOVERNMENT SKILLS AUSTRALIA, based in Adelaide and charged with caring for the national training advisory role for water, along with a range of government operations. This new Industry Skills Council replaces the functions of ALGT, the previous Industry Advisory Body which had coverage of just local government & water.

CHRIS CORR of GHD, Chair, National Representative Committee, AWA Young Water Professionals and President, AWA YWP Vic Committee was recently honoured with inclusion on Engineers Australia's list of the 30 Most Inspiring Young Engineers of 2005. Chris was also one of five finalists for the Victorian Young Engineer of the Year. 2005 has been declared the Year of the Young Engineer by Engineers Australia.

KEITH STALLARD has been appointed to take over as Director of the CRC for Water Quality and Treatment, on the retirement of DON BURSILL.

CLARE PORTER, on secondment from AWA, has now commenced work in the Sustainability Improvement Team at Melbourne Water. clare.porter@melbournewater.com.au

DAVID WILLIAMS has been appointed as the new Executive Director of the Water Industry Alliance in SA, taking over from retiring incumbent, MALCOLM COLGATE.

Dr HUANFEI JIA has joined Burns & Roe Worley's Sydney office, from CH2MHill, as a Senior Water Process Engineer: KEVIN MILLS has also recently joined Burns & Roe Worley's Sydney office, from Maunsell AECOM, as a Senior Principal Consultant

NEALE TALBOT has left his role at SKM as their Major Bid Process Manager and joined John Holland Water. Contact Neale.Talbot@jhg.com.au

PETER STEWART, Barclay Mowlem's Engineering Manager, Infrastructure has been announced as the 2005 Australian Civil Engineer of the Year. Details pstewart@bmcl.com.au

SHAUN COX (Gold Coast Water) has been elected as the new Chairman of WSAA, taking over from ANNE HOWE (SA Water). http://www.wsaa.asn.au

DARYL QUINLIVAN has been appointed as Deputy Secretary of DAFF, the Dept of Agriculture, Fisheries and Forestry. http://www.daff.gov.au

MICROBIAL POPULATION DYNAMICS IN BIOLOGICAL WASTEWATER TREATMENT

Report by Sandra Hall and Jurg Keller

The 4th IWA Activated Sludge Population Dynamics (ASPD4) conference, ASPD4 was held on the 17-20 July 2005 at the Hotel Watermark on the Gold Coast of Queensland. It was an exciting event as it was the first time the conference had been held outside Europe or North America. The conference kicked off in style with a cocktail party overlooking the night-time lights of the Gold Coast.

Activated sludge population dynamics (ASPD) is an important component of aerobic wastewater treatment processes. It aims to bring together scientists and engineers to work collaboratively on practical and fundamental problems related to the key component in the activated sludge process - the biomass (or sludge as practitioners like to call it). This conference was the fourth of its kind for the IWA Specialist Group and was a toast to the role that ASPD has played in the advancement of wastewater treatment.

The themes discussed at the conference included

- Characterisation of the organisms involved in nutrient removal,
- Storage polymers,
- Full- and lab- scale reactor studies,
- Floc structure, including filament characterisation,
- Molecular biology,
- Modelling, and
- New identification and monitoring methods.

The 3-day conference program included 38 oral presentations, 2 keynote addresses, an excellent poster display and "A night of Controversy". There were 151 participants from 27 countries, a truly international audience, which lead to good discussion from researchers, academics, students and practitioners.

Professor Linda Blackall, chair of the ASPD4 organising committee, and Dr David Garman, IWA Senior Vice-President and CEO of the Environmental Biotechnology CRC, opened the conference with a warm welcome. Keynote addresses were given by Prof Per Halkjær Neilsen (Aalborg University, Denmark) who spoke on "Population structure and ecophysiology of important microbial populations in full-scale nutrient removal wastewater treatment plants" and Prof Nancy Love (Virginia Tech, USA) who presented "Detecting microbial fingerprints and their role in advancing our understanding of activated sludge population dynamics".

While previous conferences have focused on the detection, identification and ecology of the organisms involved in the activated sludge process, the advancement of technology has allowed us to study the physiology and function of these organisms *in situ*, that is in the actual environment in which they are typically operating. While this was clearly one of the major advances at this conference, the practical problems and challenges of the treatment plants remain relatively the same. However, with progress in molecular technologies a far better understanding has been gained of the role of microorganisms in current and emerging biological wastewater treatment processes. In particular, the knowledge of the relevant organisms and their function in nutrient (nitrogen and phosphorus) removal has increased substantially in recent years, allowing better targeted monitoring and optimisation of these processes in actual plant operations. This in turn has increased the understanding of the critical competition factors between the beneficial and detrimental organisms, allowing for the operating conditions to be optimised towards the ideal growth conditions for the beneficial microorganisms. The better understanding of the complex microbial interactions in biological treatment processes has contributed to a more stable and robust performance of existing and new full-scale plants. This helps to reduce the variability of the effluent quality and therefore improving the compliance with increasingly demanding discharge licence standards

Presentation of the Ardern & Lockett Award. L-R Prof George Ekama, Dr Sandra Hall and Prof Linda Blackall.

The oral presentations stimulated the discussion of the future of the ASPD field and this was supported by the "Night of Controversy" led by our third Keynote speaker, Prof Willy Verstraete (Ghent University, Belgium). Prof Verstraete posed the questions "Has ASPD done anything to solve the practical problems facing the modern day treatment systems?". This stimulated passionate contributions from all angles, making this a great night of good laughs and excellent discussion of the topics that plague the practitioners but at the same time excite the researchers. This event certainly stimulated a number of ongoing debates about critical aspects in practice that need detailed investigations and appropriate solutions based on good knowledge generated in collaborative research.

The conference dinner was held at Dreamworld Theme Park, on the Gold Coast. The theme was "An Australian Experience" with guests being greeted by a plethora of iconic Australian animals (crocodiles, koalas, snakes, sheep), a fabulous aboriginal didgeridoo player and excellent Australian wines. Guests then boarded the steam train to be taken to the Billabong Café for the evening meal and entertainment. The highlight of the evening was the presentation of the second Ardern & Lockett award, which is given to the person, selected by the specialist group, who has made a significant life-time contribution to activated sludge population dynamics. The initial award three years ago was presented jointly to Professors David Jenkins and Dick Eikelboom for their work on filamentous organisms and sludge bulking. This year's award, presented by Prof George Ekama (University of Cape Town, South Africa), was bestowed upon Professor Linda Blackall of the Advanced Wastewater Management Centre, The University of Queensland. Linda's contributions are varied and many but it is her pioneering work on the identification of the phosphorous accumulating organisms that has credited her this award. The night didn't want to end with the DJ being begged to stay for just one more dance!

At the end of the conference, prizes for the best oral and poster presentations were awarded. The best oral presentation was awarded to Rika Jenné of the Katholieke University Leuven, Belgium, for her paper "The use of image

analysis for sludge characterisation: studying the relation between floc shape and sludge settleability". The poster prizes were awarded to:

- J.C. Williams & FL de los Reyes III "Microbial community structure of activated sludge during aerobic granulation in an annular GAP bioreactor" in Session 1 - Full- and lab-scale studies, modelling and xenobiotic compound degradation
- RL Meyer, AM Saunders and LL Blackall "Novel glycogen-accumulating organisms identified through rRNA-based stable isotope probing" for Session 2 - Nitrogen & Phosphorous removal, and
- N Nadarajah, D Grant Allen & RR Fulthorpe "The influence of activated sludge settled and unsettled bacterial community composition on settleability problems" in Session 3 - Bulking & Foaming, method evaluation and sludge structure

The conference was closed by the chair and co-chair of the Organising committee, Prof Linda Blackall and Prof Jurg Keller who thanked the International Program Committee and the Local Organising Committee for their tireless effort in organising a wonderful event.

'THE ELDER STATESMAN' OF DESALINATION

Report by Peter Addison

During September, the Water Corporation and the AWA jointly hosted a visit to Western Australia by Dr Irving Moch - a world expert in Desalination. Dr Moch is regarded by many as one of the pioneers of desalination, and has written over 70 technical papers over a career in desalination spanning 20 years.

Dr Moch presented two 2 day courses on Reverse Osmosis, to a Perth audience of over 140 people from throughout Australia.

Dr Moch received his Chemical Engineering degrees from Columbia University, New York City, and is a Director, chair of the Publications Committee and past Editor of the International Desalination Association (IDA) and Director Emeritus and former International Liaison Committee chair of the American Membrane Technology Association. He is also a member of the American Water Works Association's Membrane Standards and Water Desalting Committees.

Dr Moch worked for giant US Chemical company DuPont from the 1950s, and witnessed the start of the membrane industry. He has seen at first hand the development of membranes from their invention in the 1960's, through the first DuPont patented polyamide membrane in the 1970s, to their current very competitive market today. He is now an independent consultant, and very active on the International Desalination Association Board. He has been involved over the last 20 years in designing, advising or trouble-shooting many of the major membrane plants throughout the world, and can talk with personal experience on many water treatment issues.

The course covered membrane theory, pre-treatment, system design, energy recovery, membrane cleaning, post treatment, operating guidelines, membrane economics, and hybrid technologies. Dr Moch also outlined a CD ROM based water treatment cost model that is currently being employed as a standard for estimating plant capital and operating costs. Dr Moch indicated that some parts of the membrane market were growing at an annual rate of over 40% per year, and the lack of standardisation and large number of low priced manufacturers made it very difficult for water engineers to choose appropriate technologies.

A CD which contained several hundred pages of comprehensive course overheads and copies of selected papers was also handed out to course participants.

Peter Addison, WA Vice President for AWA, said: "Not only did we benefit from a well structured set of presentations, we also gained from Dr Moch's wide experience over several decades in water treatment throughout the world. Desalination is very active here, with over 40 plants of significant size either in operation or being planned throughout the state. This includes the 17 ML/day Kwinana Water Reclamation Plant, in full operation, the 45 Gl/year Perth Seawater Desalination Plant, currently under construction, and about 7 smaller brackish water plants being planned for the Midwest region by the Water Corporation."

For more information, contact Peter Addison on peter.addison@watercorporation.com.au.

'BREAKING DOWN THE MYTHS' - A MURRAY-DARLING BASIN FORUM

Chris Davis, AWA CEO

An interesting forum and site visits took place in St George, Queensland late in October, with the challenging title - *Breaking Down the Myths.* The organiser, new to me, was the Southern Inland Queensland Area Consultative Committee, or ACC. There are 56 ACCs around Australia, auspiced by DOTARS (Dept of Transport and Regional Services) to attend to regional development priorities.

The SIQ ACC was prompted to arrange this forum because of concern over perceptions around Australia that Queensland grabs more water than it should from the Murray-Darling. About 30 people from around the country gathered in the picturesque and

tidy town of St George, to thrash out issues and to inspect the iconic/notorious Cubbie Station and other local sites.

The delegates came from many spheres, but leaned towards irrigation, so constituted a mostly sympathetic audience over the two days of site visits and discussions. Chairmen of ACCs in some other regions attended, and so did representatives from DOTARS, DAFF and DEH, as well as downstream irrigators, AWA and the Murray-Darling Association.

It became clear early on that the Darling River system is currently in the throes of the worst drought since records have been kept. This has had a profound impact on river flows and irrigation activities. Several speakers during the forum reinforced that point. Ross Krebs, from Natural Resources and Mines (Qld) illustrated the massive natural variation in annual flows that occurs in many Queensland river basins. This means that maximum flows are huge, averages are modest and the minimum flow in many inland rivers is simply zero, quite a lot of the time.

A major drawcard for the forum was a visit to Cubbie Station, which is regularly excoriated in the media. The first impression is the sheer size of the property, the largest cotton farm in Australia and perhaps in the Southern Hemisphere. The property is tens of kilometres long and about 20km wide, covering 80,000 ha. The area of cotton potentially planted is 14,000 ha, storages cover 10,000 ha, 24,000 ha is grazing land and 32,000 ha is remnant vegetation. Of the remnant vegetation, a fair proportion is actually floodplain, which channels high flows in between storages and cotton fields.

Water from the two upstream river systems, principally the Culgoa River, is diverted by gravity and some pumping, into turkey's nest dams, of which there are about 35. Initially, the depth of storages was typically 2.5 to 3m (a regulatory constraint) but recent relaxation has enabled Cubbie to deepen them to 5.5 to 6m. Diversion is only allowed on an *event driven* basis. This means that, for the Culgoa River, flow over the Jack Taylor Weir in St George must exceed 3,000 ML/d before harvesting can begin. After a recent review, headed up by Prof Peter Cullen, DNRM must also give permission for diversion to commence. This means that a long dry spell can be followed by an initial environmental release, before any extraction takes place. Once diversion begins, it has to be pro rata to the weir flow, reaching a maximum of 9,000 ML/d when weir flow is 60,000 ML/d. A similar arrangement applies to the Balonne Minor River, such that the maximum withdrawal rate is 1,800 ML/d, at a weir flow of 20,000 ML/d; this means the combined diversions peak at 10,800 ML/d when combined weir flows are 80,000 ML/d. During diversions, Cubbie Station must report all data daily to the DNRM.

A corner of a field at Cubbie Station, to give some impression of the scale of the infrastructure.

Once water flows into one or more of the Cubbie storages, it can be gravitated to any of the cotton fields and a system of pumps can transfer water from anywhere on the property to anywhere else. No water leaves the site, as drainage and runoff is all collected and pumped for use on irrigation. This in itself must have a major impact during rain, as the site is so large.

When cotton is irrigated, a channel from the storage is opened and smaller gates are opened at 32m intervals, draining water into the top end of a field; it runs across and inundates all the cotton. This operation, and all the pumping, is done manually, for simplicity and to ensure that everything is seen to be going according to plan. Pump stations are simple, with sloping intakes and 'china' pumps. To start a pump station, the operator first uses a vacuum pump to prime the main pump, then starts the diesel motor that drives the pump. Diesel use is a major cost component of operation.

There are roughly 40 of Cubbie's own staff, supplemented by about 200 contractors.

Although there is now potentially 14,000 ha of cotton, the lack of rainfall has meant that, in the last five years, actual plantings have represented anywhere from nil to 70% of the total; the average being 20%. This year, 10% of the area is planted. The implication is that revenue for the operation can range from almost nothing to very substantial, depending entirely on the vagaries of river flow. Wheat is grown opportunistically in some of the fields when cotton isn't planted, and in rotation with cotton.

Following criticism of the impact of Cubbie Station on the health of the river, Lee Benson has been engaged and conducts bi-annual surveys of biodiversity and other river health indicators at several key sites downstream. So far, indications are that river health has not been degraded.

During the forum and site visits, there was intense debate with Tony Schneider, a NSW floodplain irrigator, whose accustomed flows have simply not happened in recent years. The fact that water passing Cubbie doesn't reach downstream users seems to be owed partially to natural attenuation; but there are also questions about other diversions and gaps in metering. The State used to have some 600 gauging stations, which were whittled back to about half that number over the last 20 years or so. Recently, hydrography has been reinstated and the number of stations is creeping up again, which is also good for the whole effort to understand what's happening to the water in the system.

A major factor in the Cubbie water balance is evaporative losses. Thanks to hot, dry, windy conditions and the

One of Cubbie Station's older, smaller pump stations, with 800 dia. suction lines.

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Melons under plastic and with drip tape irrigation, Moon Rocks, Queensland.

impact of a water body surrounded by a dry area, daily evaporation can reach 14mm and annual evaporation is around 2m. This means that overall losses can amount to about 50% of the diverted water. Cubbie has responded by deepening the storages to reduce the surface-to-volume ratio (as outlined above); by consolidating storages whenever possible; and even by experimenting (unsuccessfully, so far) with application of a chemical monolayer to the surface of a storage. The layer has to be aerially re-applied every two or three days and is soon dissipated by wind. Seepage is one area that doesn't pose a challenge - the rich, black soil holds water well.

My impression is that Cubbie Station is managed rigorously, within its regulatory framework. Clearly, many would argue that the framework is not optimal, but it is what it is, and the way extractions from the river are managed is appropriate for the circumstances. Given the vagaries of river flows in the region, Cubbie shares the pain with all other users and rarely plants more than a fraction of its available area. Management and staff at the Station are frank and open with data and information generally and they seem willing to interact and to defend the operation in rational debate. Clearly, the whole operation is very opportunistic, in terms of balancing the generally dry periods and minimal production against the occasional flood time when all fields can be planted and a very significant crop harvested.

Overall, while the notion of such a massive water use being imposed on an ephemeral water system is anathema to many, Cubbie Station is neither out of control nor irresponsible within its regulatory terms of reference.

After visiting Cubbie Station, the party moved on to inspect Moon Rocks, owned by the Moon family. They began the farm initially to produce cotton farm, but soon decided that growing cotton was just too hard, so opted to revert to what the family had long been involved with - horticulture.

Allocation water is stored in dams (Moon Rocks has had its own problems trying to minimise evaporation losses by technical methods) and then applied by buried drip tapes to the crops. Melons are planted by hand under plastic sheeting, after the drip tapes have first been buried. Layout is critical so the various vehicles don't rip up the drip tape after a season.

Production is around 5,000 t/yr of rock melons; 2,000 t/yr of brown onions; table grapes and a small amount of cotton. Sophisticated handling and storage systems have been evolved to ensure optimum product quality; for instance, melons are floated along flumes in the packing sheds, rather than being rolled or pushed on hard surfaces. Onions are dried and stored to maximise their market appeal. Supplying to the exacting demands of market leaders Coles and Woolworths requires a large scale and meticulous attention to detail.

The last visit for the day was to Riversands Winery, which grows a variety of table and wine grapes, all with drip irrigation. Standard, above-ground driplines are used and they are, in fact, higher than usual to ensure that weeding and cleaning operations don't threaten the lines. Empirical experiences with the grapes has shown that using much higher irrigation rates, ie 10 m/yr rather than 2.5 m/yr, results in a huge improvement in grape quality. Although this bucks the trend towards minimum water use, it has led to a net gain in productivity. A series of monitoring piezometer holes allows use of a handheld monitor to digitally collect water up and down the soil profile, so the twice weekly irrigation can be optimally scheduled. Another challenge for grape growers is picking the right varieties, hoping they will still be in demand when the vines begin producing.

In closing discussions it was obvious that members of the irrigation community strongly resent the notion of buying water away from irrigation districts, as it has the potential to diminish employment in the area and to strand the remaining irrigation assets. Equally, they oppose the idea of making up the deficit in the Living Murray target of 500 GL/yr (there is still some 240 GL outstanding) by buying water on the market.

No solutions to the water conundrum here, but at least all the participants came away with a clearer picture of the water situation in inland Queensland, and just how challenging the irrigation ventures are.

NT BRANCH - WATER IN THE BUSH

Nic Morgan, Conference Convenor

On Thursday 20 October 2005, as part of National Water Week, the Northern Territory Branch of the AWA held it's annual Water in the Bush conference in Darwin. Water in the Bush is the premier event on the NT's water-industry calendar and brought together almost 70 delegates from across the NT. The conference consisted of 12 presentations and a conference dinner. The event was opened with a thought-provoking address by His Honour, Mr Ted Egan AO, Administrator of the Northern Territory. Highlights of the day included presentations such as *Big Wets, Wet Wets, Dry Wets and Little Wets - Rainfall Variability and Trends in the Territory's Top End* by Sam Cleland (Bureau of Meteorology), *Investigation into the Pathogen Naegleria fowlerii - An NT Perspective* by Alex Donald (Power and Water Corporation) and a session on *Water for Indigenous Communities.*

The conference was a huge success and the NT branch would like to thank major sponsors Open Spatial Australia, Tyco Water and Power and Water Corporation for their support.

Des Yin Foo's presentation on Modelling the Impacts of Groundwater Usage in the Darwin Rural area.

REDUCING THE SALT CONTENT OF WASTEWATER

N Corby

Abstract

The recent drought emphasised the vulnerability of Victoria's Water resources. In response, the Victorian Government has set two targets for the Melbourne Metropolitan Water retailers: reduce potable water consumption by 15% per capita and achieve 20% effluent recycling from Melbourne's sewage treatment plants by the year 2010.

However, Total Dissolved Solids (TDS) loads to sewer are a limiting factor for effluent reuse from the Western Treatment Plant (WTP).

This paper outlines the strategy that City West Water (CWW) has employed to reduce TDS loads from their industrial customers through Cleaner Production, and specifically describes the research and development program.

The first stage involves working with high TDS discharging customers on the development of Trade Waste and Water Resource Management Plans, guidelines of which have been developed by CWW in partnership with the Environment Protection Authority Victoria (EPA Victoria). Other mechanisms include the Water Smart Industry Demonstration Projects, the Cleaner Production research and development program as well as a number of partnerships with research institutions, regulatory bodies and industry organisations.

Introduction

City West Water (CWW) is one of the three water retailers in the city of Melbourne and in the last 18 months has made a dramatic shift in the manner in which it deals with its industrial customers.

Since the implementation of the Victorian Government's White Paper, Our Water Our Future. that outlined the requirement to achieve 15% potable water reductions per capita and 20% treated effluent recycling, CWW saw an opportunity to engage it's customers.

While maintaining the management of risk and compliance from the trade waste standpoint, CWW also began working with customers on cooperative initiatives to reduce water consumption and the discharge of trade waste to the sewer.

Table 1. Common inorganic TDS species.

Cations	Anions
Sodium (Na^+)	Chloride (Cl^-)
Calcium (Ca^{2+})	Sulphate (SO_4^{2-})
Magnesium (Mg^{2+})	Carbonate (CO_3^{2-})
Ammonium (NH_4^+)	Nitrate (NO_3^{2-})

And so, the CWW Cleaner Production Strategy was created.

The Victorian Government's Salt Reduction Strategy for WTP aims to reduce salt in the recycled water by 40% by 2009. To achieve this the strategy outlines actions that need to be taken, including; working with detergent manufacturers to reduce the salt being introduced to the sewer through household washing detergents and assessment of the options needed to desalinate treated effluent required for recycling.

CWW's Cleaner Production Strategy has been developed to address the industrial component of salt entering WTP. It is principally concerned with reducing consumption of potable water among large users and the discharge of salt and other pollutants. Cleaner production critically analyses processes and investigates alternative approaches to waste, utilising the waste minimisation hierarchy to produce triple bottom line benefits.

Working with the customers and giving them the tools.

CWW is in a unique position to implement these changes within industry since it has the highest concentration of heavy industrial trade waste in Australia.

Melbourne's western suburbs have long been the manufacturing heartland of Australia. Leveraging off CWW's existing structure and processes for managing trade waste discharged to its sewers, the cleaner production team is working with trade waste customers to develop and implement Water Management Plans (WMP) and Resource Management Plans (RMP) to produce process and operational changes that enable triple bottom line benefits for both the customer and the community.

This paper highlights the strategy employed to promote cleaner production to CWW's customers, with particular focus to the research and development program of CWW's Cleaner Production Strategy.

In 2004 CWW budgeted over $1 million over three years on developing the tools and investigating the projects to facilitate the achievement of reducing potable water and TDS discharge.

Background

For over 100 years WTP, located at Werribee on the western shore of Melbourne's Port Phillip Bay, has been managed in such a way to limit the impact effluent discharge has on the Bay's ecosystem.

More recently the plant has had significant upgrades and is now moving away from previously utilised grass filtration systems to activated sludge treatment processes. These upgrades have improved the quality of treated effluent such that it can be considered for off-site reuse.

TDS loads to sewer are a common limiting factor for effluent reuse. Importantly at WTP, the TDS levels are higher than acceptable for long term beneficial reuse options in the area. More specifically it is the inorganic component of TDS that affects the reusability of treated effluent. Common inorganic species found in the treated effluent leaving WTP are shown in Table 1.

The presence of inorganic TDS in irrigation water can have detrimental effects on the plants through leaf burn and osmotic effects. In addition TDS affects the soil through cation exchange, the substitution of Na for Ca and Mg ions, which changes soil structure.

The degree to which this may occur is related to the ratio of sodium, calcium and magnesium ions, measured by the Sodium Adsorption Ratio (SAR). Agricultural studies have indicated for long-term sustainable off-site reuse the treated effluent from WTP requires a reduction of

40% in the concentration of TDS and a SAR of less than 10.

Inorganic salt compounds are an important chemical used in many industries including textiles, tanning and chemical manufacture. These materials are relatively inexpensive to both buy and dispose of, and, with treated effluent being discharged to a saline estuary their presence in trade waste in the past has not been an issue. More recently, with the need to reuse treated effluent for irrigation purposes off-site, high salt levels in treated effluent have become an issue of concern.

Approximately 550 tonnes per day of TDS enter WTP. It has been estimated that 30% of this TDS, or 168 tonnes per day, emanates from CWW's customer base trade waste discharge. Approximately 80% of this load is discharged by 30 of CWW's customers. These 30 customers have been the focus of the Trade Waste Cleaner Production Team over 2004-05.

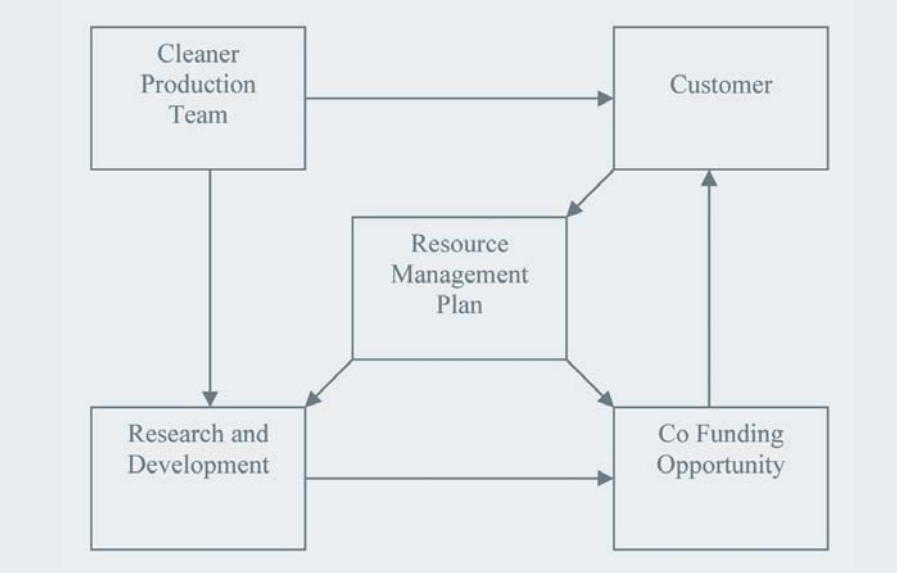

Figure 1. Cleaner Production Strategy customer engagement and assistance through resources.

Cleaner Production Team

The cleaner production team was formed from the Trade Waste department, to focus on water efficiencies of large potable water consumers and reduce TDS discharge by industry.

In the early stages of the program it was discovered that a major hindrance to the implementation of cleaner production principles was the lack of framework or tools to facilitate the analysis of a processes and allow the generation of improvements.

Trade Waste and Water Resource Management Plan Guidelines were developed in cooperation with EPA Victoria. These have been used to develop almost 30 plans with major TDS discharging and water consuming customers, which have also identified many reduction projects. Some of these projects require further development and have fed into the research and development phase of the cleaner production strategy.

Operating in parallel with the trade waste cleaner production team's aim to reduce TDS is the focus on water conservation. This specifically involves the development of Water Management Plans for the commercial and institutional water users in Melbourne's top 200 program. A number of assessment and implementation methods have been employed to reduce water consumption on these sites, and the development of these plans continues to identify opportunities to increase water use efficiency by the customer.

The Cleaner Production Research and Development program is an important aspect of the CWW Cleaner Production Strategy. Projects under this program are designed to bridge the gap that exists between current and emerging technologies and their application at industrial sites. Projects are developed to encourage moving from an end-of-pipe mentality of dealing with waste to that of at- source reduction. Potential projects are assessed over a range of criteria taking into account the importance of such a study to CWW and its stakeholders, the customers it involves, the risk of success, the eventual effects if successful and the monetary costs. This rigorous assessment determined where funds should be allocated for the best return for the customer, CWW, its stakeholders and the wider community.

Partnerships

The heavy industrial nature of CWW's trade waste customers provided an opportunity for CWW to engage its customers through a number of avenues. The first partnership developed was with EPA Victoria. In August of 2004 CWW and EPA Victoria signed a memorandum of understanding demonstrating from both organisations a commitment to working toward sustainability through cleaner production. A close relationship has since developed resulting in the TWWRMP guidelines and co-investment in a number of important projects across industrial sites and sectors. This partnership has been particularly useful in facilitating co-operation and in the transfer of knowledge between the two organisations and customers.

Similar partnerships are also being developed with Sustainability Victoria (SV) and industry groups such as Plastics and Chemicals Industry Association (PACIA).

CWW have developed relationships with Melbourne's tertiary education institutions. Memoranda of Understanding have been signed with RMIT University (RMIT) and Victoria University (VU). A number of projects involving undergraduate and postgraduate students are exploring opportunities to reduce TDS discharge and increase water consumption efficiency in industry. In this way students are presented with actual industry experience to further their theoretical knowledge.

Identifying Projects

As part of CWW's trade waste management customers are required under their trade waste agreement to submit self-monitoring analysis of their trade waste effluent. One component of this self-monitoring is the submission of 24-hour composite data, usually spanning over a three to seven day period.

Analysis of this data determined which customers and industrial sectors were discharging the majority of the TDS.

A customer engagement program began whereby CWW's cleaner production consultants worked directly with customers to identify where water was being used and TDS created as a waste. From this identification process, projects were developed that addressed the TDS.

The following are examples of completed or ongoing projects that will allow CWW to work with its customers to reduce the TDS entering WTP and allow for a sustainable resource of recycled water to be supplied to further customers.

Individual Customer Projects

Orica Chloralkali Plant

In March 2005 CWW funded an investigation into the removal of sulphates from a brine waste stream produced by a major salt discharging Chloralkali plant owned and operated by Orica in Laverton (Figure 2.). The chloralkali process is a relatively simple one involving the electrolysis of sodium chloride brine into chlorine gas and sodium hydroxide. Other products such as sodium hypochlorite and hydrochloric acid are also manufactured onsite as a result of subsequent processing.

The raw material for the process is sodium chloride which is purchased as solar salt. Within this material there are impurities such as calcium, magnesium and sulphate. The calcium and magnesium (along with other impurities) are removed through a number of processes including ion exchange, however the sulphates cannot be removed this way. The spent brine stream after electrolysis, is recycled back as raw material. To do this a purge stream must be removed to prevent the accumulation of sulphates within the system. This purge is passed through a nano-filter which further concentrates the sulphates, recycling the sodium chloride rich filtrate. This waste stream consists of 28% sodium sulphate, the remainder being predominantly sodium chloride.

A consultant was engaged by Orica and CWW to continue investigations into removing the sulphates by precipitation allowing the aqueous solution of sodium chloride to be recycled. Precipitation with calcium chloride is the process option with the lowest operating and capital cost.

However this option produced a significant operating loss. These findings were particularly sensitive to the high disposal charges of the calcium sulphate sludge as prescribed industrial waste, and the significantly lower charge of disposing the solids to the sewer as TDS. While this option to dispose of the calcium sulphate as waste has proved economically unfeasible, work continues on finding a possible use for this material to transform the waste into a resource.

Tasman Group Services Meat Processing Facility

The meat processing industry is a major consumer of water.

In 2004 CWW were involved in a project whereby two students from RMIT Environmental Engineering Department conducted their major project on a major livestock (cattle and sheep) processing facility owned and operated by Tasman Group Services (TGS), located in Brooklyn.

Figure 2. Orica Chloralkali Facility.

Over the year, the first project involved in evaluating the waste treatment systems on the site. The other project consisted of a cleaner production exercise including a water audit. The program was considered such a success that TGS decided to participate in the program again this year.

Throughout 2005 has been an honours student from the School of Applied Sciences, RMIT, conducting a further study into cleaner production initiatives. Important analysis has been conducted over the site including evaluation of the effectiveness of a range of sprinkler cleaning systems, evaluating procedural operation in resource recovery and determining the real cost of water per unit of product for the site.

It has been found that by taking a holistic view of waste, what were previously considered projects with long financial returns are actually in reality economically viable. Further work still needs to be completed but there is a solid foundation to work on as determined by the RMIT student.

Industrial Sector Projects

Altona Chemical Complex

The Altona Chemical Complex contains a number of Melbourne's biggest water users and TDS dischargers.

The complex contains industry predominantly manufacturing chemicals and plastics, with a range of manufacturing techniques. Due to the high water use and high TDS discharge of the customers within the complex CWW and EPA Victoria realised that there was an opportunity to conduct a Process Integration Study in and across the four customer sites, and to investigate the possibility of internal and complex wide synergies, to reduce the potable water consumption and lower the TDS discharge from the sites. This study, which involves carrying out mass balances, computer modelling and option evaluation is involves four customers, CWW, EPA Victoria and PACIA.

Clean In Place Technology

An important barrier to the uptake of new technology is the risk involved in changing a process over to an untested technology.

Caustic (sodium hydroxide) based cleaning products are the traditional cleaning chemicals of choice for the food and beverage industry. Clean In Place systems that clean piping and instrumentation at the end of each product run are significant contributors to TDS in trade waste.

Recently there has been a proliferation of alternative "green" products, low in sodium, that claim to accomplish the job of traditional cleaning products. CWW has engaged Deakin University to conduct a literature study of commercially available cleaning agents and compile a number of case studies whereby these alternative chemicals have been used in industry to positive effect.

With independent information such as this CWW can confidently approach their customers in the food and beverage industry with these alternative products and co-invest in trialling their effectiveness, leading to their eventual use by industry, to reduce sodium discharged to sewer.

Industry Wide Projects

The most common piece of equipment that is found on an industrial site to treat trade waste before discharge is the pH neutralisation apparatus. This will typically consist of a pH sensor and two tanks of concentrated acid an alkali respectively. Based upon feedback control, acid or alkali is dosed to ensure the effluent to be discharged is within the pH range as allowed under the authority's trade waste agreement. This range for the majority of CWW's customers is between a pH value of

6 and 10. The chemicals commonly used for this process are typically hydrochloric acid and Sodium Hydroxide, the two most problematic species for reuse.

Neutralisation Chemicals

The neutralising agent in most extensive use is sodium hydroxide. Most industrial processes in CWW area produce an acid waste stream, which must be neutralised with Caustic before discharge. There are however alternatives to sodium hydroxide.

A student from Victoria University is currently undertaking a study into the chemistry of pH neutralising chemicals, specifically alternatives to sodium hydroxide. There are a number of alternative alkali neutralising agents that are commercially available, however their application is limited due to the efficiency around using caustic. Caustic does not incur the cost of using potassium hydroxide, the difficulty in solids handling when using lime, or the slow reaction time of magnesium hydroxide. This study is looking at these chemicals and evaluating when they are best applied. Trials have even shown that combinations of more than one of these chemicals can also have the effect of heavy metal precipitation. Though still in its infancy the concept of substituting caustic requirements with alternatives to improve the SAR of reuse water may have wide spread application.

Trade Waste Discharge pH Limits

Moving still further up the waste minimisation hierarchy, as shown in Figure 3., the question of whether neutralising is actually necessary is arrived at.

In 1995 the Trade Waste Acceptance Advisory Committee reviewed the current trade waste discharge pH range in trade waste discharged to Melbourne's sewers. It came to the conclusion that in the absence of any driver the limits should remain set at 6 to 10. These limits are based upon the perceived risk to the sewer worker, sewer infrastructure and treatment processes that may result from the discharge of trade waste outside of this range. The understanding of this interaction however is not well known.

In October 2004 CWW sponsored an RMIT masters student to investigate the current pH limits and evaluate their continued applicability in light of the requirement to reduce TDS entering WTP.

The occupational health and safety risk posed by accepting trade waste outside of this range emanates predominantly from the possibility of production of hydrogen sulphide and ammonia gases. Under certain conditions, these gases can be created in the sewer system leading to risk for workers within the sewer, to infrastructure through corrosion.

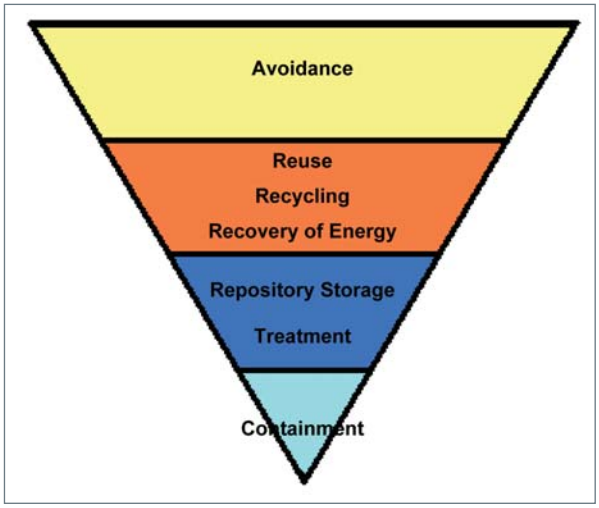

Figure 3. The waste minimisation hierarchy.

The project is exploring the possibility of extending this pH range if it can be demonstrated that there is little risk in discharge. This project is investigating the reactions that occur at the interface between an industrial site and the sewer system and will determine what types of trade waste at what pH are safe to discharge. Recent sampling of the influent to WTP has suggested that the raw sewage contains high alkalinity, suggesting that the sewage may have the buffering capacity to absorb low pH trade waste without significant change in the pH overall. Further modelling and validation must be completed before trials at industrial sites are to occur.

Future Challenges

The key focus of the cleaner production strategy is customer engagement. It is through working with a customer and giving them the tools to discover their own initiatives that real ownership takes place.

CWW can assist in identification of options and technologies, but big gains can be made in improved housekeeping. This cultural change presents the biggest challenge to implementing cleaner production in many industries. However CWW is becoming equipped with the tools to facilitate the promotion of the benefits offered by cleaner production options.

A further challenge will be the engagement of small to medium enterprises. These customers, though individually small, are collectively a large contributor to the sewer system. Through intelligent direction of funding, research and customer involvement the cleaner production team will endeavour to address the issues that arise from these customers.

CWW's role is to continue working with customers on their individual issues and to remain focused on the larger issue of improving the viability of recycled water. The future however though, holds further challenges for CWW with other parameters of concern such as heavy metals and nutrients. An increasingly holistic approach will be required to address the medium to small trade waste dischargers and households.

Conclusion

The Cleaner Production Strategy was developed to address the needs of the greater community in securing the sustainability of water resources.

The strategy predominantly involves engaging large trade waste customers and developing Trade Waste and Water Resource Management Plans to identify options to assist customers reduce the volume of water used and discharged. To support this overriding strategy a research and development program has been developed to develop ideas and the tools CWW and its customers require to implement cleaner production.

With a focused "up-the-pipe" approach to at-source reduction of waste, CWW will continue to assist its customers to achieve the significant benefits that are now beginning to be realised.

In 2005 the Essential Services Commission approved of CWW's Water Plan. This plan introduced for the first time a load-based charge on the discharge of TDS in Melbourne, among a range of other adjustments results in a more risk based pricing system. The plan also outlines provision for the funding of the Cleaner Production Strategy. This funding for the three year life of the Plan equated to $6.5 million, which provides for the research and development program, assistance in the development of resource management plans and a grants scheme for customers to implement capital works on industrial sites to achieve improved efficiencies.

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TRADE WASTE TREATMENT: PROJECTS UNDERTAKEN BY RMIT UNIVERSITY STUDENTS

B Meehan

Introduction

As mentioned in the preceding paper (Corby N, this issue) City West Water (CWW) has signed a Memorandum of Understanding with RMIT University to assist in reduction of trade wastes from the heavy industries of west Melbourne, in particular to reduce the load of salt discharged to Melbourne's Western Treatment Plant. The first projects under the arrangement took place in 2004 through the School of Applied Science involving Environmental Science and Environmental Engineering students and has this year been extended to involve students in the School of Civil and Chemical Engineering.

Examples of some projects are summarised in this paper. It is worthy of note that the approach of involving students, both graduates and undergraduates, directly with industry and the water authority, has not only generated information and ideas useful to the 'clients' but also has enhanced the skills and employability of the students.

The results of all projects have been presented at meetings of various water authority staff, EPA and industry representatives.

The operating costs for the projects at the abattoir undertaken in 2004 were funded by the National Meat Industry Training Advisory Council Limited (MINTRAC) Scholarship Program. In addition CWW provided scholarship support under the partnership agreement for all of the 2004 and 2005 projects.

Projects through the School of Applied Science - supervised by Dr Barry Meehan

Honours and final year design projects

Project one. Treatment and recycling of high-strength wastewater from an abattoir (Kieran Condran, Environmental Engineering)

The processes carried out in abattoirs require large amounts water and the majority of the processes require fresh/potable water. Potable water however is quickly becoming an expensive resource and there is increasing economic pressure being placed on industries such as the meat industry to implement cleaner production initiatives to reduce their water use. This project investigated various treatment methods to treat the effluent discharged by a Melbourne abattoir to a reusable potable quality.

Currently water from the site is primarily treated to remove gross solids, fats and grease prior to discharge to the collecting water authority, City West Water. The wastewater treatment currently employed at the facility involves simple screening of the effluent before it is passed through a Dissolved Air Flotation (DAF) system. This water is then discharged to sewer under a trade waste agreement as a category 3 trade waste. There is great potential to reuse this water in the plant if it can be treated economically for the primary reason of reducing current water expenditure and also to reduce their impact on the Melbourne sewer. The nature of the pollutants in abattoir effluent, principally the high BOD levels, elevated temperature and high concentration of suspended solids and nutrients, reduces the secondary treatment options to activated biological treatment. This project investigated many different treatment strategies that could be implemented at the site. The key components of the system were considered to be:

- removal of suspended solids (SS) and oxygen demanding constituents from the effluent i.e. BOD, COD and conversion of ammonia into harmless nitrogen gas;
- removal of colour;
- removal of harmful organisms, i.e. bacteria, viruses, etc;
- removal of TDS.

To achieve the first of the parameters as stated above, biological treatment is the only method that will successfully remove BOD and other oxygen demanding constituents. The investigation found that a Membrane Bioreactor (MBR) unit would be the most appropriate treatment solution in this case. The MBR unit would reduce BOD, COD and ammonia by greater then 97% and also reduce SS by 99%. It will also remove the majority of the colour and primarily disinfect the water prior to further treatment. (Wasted biomass from the bioreactor unit can be dried and further treated by a neighbouring organic waste handling facility).

The only technology currently available able to achieve removal of TDS is Reverse Osmosis (RO). Thorough investigation found that RO can be implemented economically. A recommendation was made to install a modular RO system downstream of the MBR unit to treat 1000KL/day of water for reuse in the plant in hot water applications such as:

- sterilising water;
- plant cleaning operations at the conclusion of processing;
- cooking tripe.

The remaining 1000KL/day of treated water from the MBR unit can be reused in other applications that do not require the use of potable water, such as cattle wash, truck wash and also possible transfer to a neighbouring site for use in dust suppression. It is also an option to install a larger RO plant to treat all of the water back to a potable standard but this was seen as unnecessary at this stage as the remaining water can be used in other ways without outlaying the capital required for the larger RO operation. A modular RO system allows for expansion in the future if it is seen as necessary.

Final Disinfection would still be required of the water prior to its reuse in the plant. The recommendation is that chlorine be used to disinfect all water extracted from the R.O unit prior to reuse in the plant, to ensure that pathogenic organisms are eradicated.

The implementation of the first of these options will cost about $2.5 M and potentially provide an annual cost saving of close to $800,000 and provide 1000KL/day of potable water for reuse. The projected payback period for this project is just over three years.

Implementation of the second option generates annual cost savings close to $650,000 thus giving a projected payback period of 4.5 years and providing up to 2ML of potable water within the plant.

The shorter payback period of the first option shows that it is the more appropriate option to implement. A modular R.O plant still allows for expansion in the future if the need exists.

Project two. Hydrocyclone systems for high strength abattoir wastewater (Brigid Adams, Environmental Engineering)

The project focused specifically on the use of hydrocyclone technology in wastewater treatment in two abattoir sites. A plant in Tasmania already had a small hydrocyclone system installed and the aim was to investigate the feasibility of an upgraded hydrocyclone system at that site and replacement of an existing wastewater treatment system at a Melbourne site owned by the same group. Two design strategies were investigated - one with minimal capital expenditure utilising the current infrastructure, and another which involved a full-scale system upgrade for the Melbourne plant.

The first design at the Tasmania site required little capital expenditure, with immediate improvement in results. It involved redirecting the yard wash down-stream directly to the Save-all with a separate side stream from the red wastewater stream for treatment through the current hydrocyclone system. This system results in the recovery of high quality tallow which can be utilised in the rendering plant, earning income for the company, while effectively treating the wastewater. The improved design will also reduce operator maintenance time and costs. The small size of the system does not offer an immense impact on the overall effluent quality, but does offer a significant contribution. The modifications are inexpensive yielding a return on investment of less than six months.

A second design strategy was for the long term. This design utilises a larger hydrocyclone system to treat the entire flow (apart from the yard wash down- stream). It also incorporates the existing smaller hydrocyclone as a concentrator system, further thickening and increasing the quality of the recovered tallow. The large-scale hydrocyclone will treat the entire flow and remove the need for other treatment techniques such as Dissolved Air Flotation. It offers an oil and grease removal efficiency of between 80 and 93%.

The capital expenditure is comparable with installing other types of treatment systems, with a return on investment of less than six months However, the by-product recovery greatly enhances the rewards. The system requires little operator attention, takes up minimal space and provides raw product for the rendering plant. The effluent targets in the Trade Waste Agreement with the local authority will be easily reached and maintenance and power costs will be reduced in the tertiary system.

Installation of a hydrocyclone system at the Melbourne meatworks would offer similar benefits to the Tasmanian site. The cost of installation would be similar and the income made through tallow recovery would allow the system to pay itself off in 6-12 months. In both of the design options, process flow diagrams and associated calculations, removal efficiencies, and cost benefit analysis were carried out.

Project three. Cleaner production studies (Alice Laws, Environmental Engineering Vincent Carson, Environmental Science)

In 2004 a preliminary cleaner production investigation was carried out at the abattoir described in Project one. The project was designed to assess and evaluate the current water practices and recommend where improvements can be made, focussing on reducing the consumption of water and reducing volumes and pollutant loads of the effluent discharge.

Wastewater essentially comes from four main areas:

- kill floor (slaughterhouse) and viscera tables;
- paunch contents;
- rendering operations;
- holding pens (stockyards) and animal wash-down.

The following observations were recorded during a series of site inspections at the beginning of the investigation:

- ineffective grates and sieves;
- general water wastage (leaking equipment, no triggers on hoses, low pressure hoses);
- ineffective blood collection process allowing high BOD and nutrients to enter the effluent.

By regular discussions with site engineers, and comprehensive literature reviews of cleaner production strategies in abattoirs and other industries with similar wastewater issues, the following design options were investigated and developed to provide the company with low-cost, sustainable and effective water management strategies:

- fitting efficient triggers onto hoses in stock-handling areas;
- installing compressors to maintain high pressure in hoses;
- adding grate system or dewatering screw to stockyards to reduce BOD and TDS levels before they reach the wastewater pits;
- improving blood collection in kill floors;
- establishing a regular inspection and maintenance program;
- reusing captured rainwater in non-food processing applications;
- dry cleaning before final wash-down;
- installing screens in baskets and use a wrench/basket conveyor system in water pits;
- improving grease separators.

Many of the measures listed above have been further investigated by the company and the report has assisted in the targeting of areas for attention. Minimising water usage, reducing treatment volumes and discharging cleaner water will not only financially benefit the abattoir but also serve as an example of the effectiveness of these measures to similar facilities.

In a second project, a detailed water audit was undertaken in 2005 in order to quantify the effects of introducing a number of the cleaner production measures suggested above. Further recommendations were made for reuse of relatively clean wastewater in a number of disposal chutes and also the retrofitting of tap fittings in several exit and entry areas to boning rooms and kill floors.

These recommendations have been adopted by the company on the basis of a comprehensive cost-benefit analysis carried out as part of this second project.

Project four. Wool processing effluent (Marcus Ingrouille, Environmental Engineering)

The project investigated the processing procedures used to scour and carbonise wool, recover grease and treat effluent at a Melbourne wool processing plant. The overall aim was to quantify the water usage and compile the information necessary to undertake improvements to the plant's wastewater treatment facilities.

The final project report included a detailed flow-sheet of all water-using activities on the site together with a technical description of each process. It provides a diagrammatic model of the process, showing the arrangement and interconnectivity of the equipment in a form that can be used by consultants and vendors in later process optimisation, cleaner production or effluent treatment improvements. No such information existed before this investigation was undertaken.

This project also evaluated the suitability of installing a chemical flocculation system at the site. The system studied would result in a drastic reduction in pollution loading in effluent leaving the site, with the system typically removing 95% of suspended solids and 75% of BOD in the water that it treats. This would reduce the plant's trade waste costs by approximately $82,000 a year, however, the estimated operating and capital costs could be significant, and it was concluded on the basis of this preliminary cost benefit analysis that it was economically unfeasible. However in 2005, due to changed circumstances, the company has adopted these recommendations despite the significant capital expenditure and is presently installing a CF system.

Postgraduate project

TDS reduction through adjustment of pH discharge limits (Trish Miller, Environmental Science)

This project is the first postgraduate project undertaken at RMIT University as part of the CWW - RMIT partnership arrangement. It involves a Masters student working in collaboration with the cleaner production team at CWW investigating the reduction of total dissolved solids (TDS) inputs into the Melbourne sewer (see Corby N, this issue).

For trade waste compliance, industries must neutralise trade waste before discharging into the sewer, thus increasing the amount of TDS by the use of either acid or base. The discharge range for pH is 6-10. In 1995 the current discharge limits to the sewer system were reviewed and it was recommended that no change would be made. In conjunction with City West Water and Melbourne Water an investigation is currently in progress to determine if the pH discharge limit range can be broadened in order to achieve a reduction in the amount of TDS being discharged. Mixing of waste streams is being investigated to identify opportunities for pH neutralisation before discharge.

Theoretically, broadening pH discharges limits could increase the in-sewer evolution of ammonia or hydrogen sulfide. However, in order to predict the effects in the actual sewer it is essential to know the chemical characteristics of the wastewater. Waste stream characteristics over extended periods were unavailable. In March and May of 2005 an intensive sampling program was conducted. Forty-four parameters were analysed hourly which included pH, acidity, alkalinity, TDS, ammonia, sulfide, and a suite of heavy metals.

A distinctive peak in the TDS concentration and load was seen over the sampling duration, occurring in the mid afternoon between 15.00 and 18.00 hours. These three hours contained 22% of the daily TDS Load, sodium chloride levels contributing 79% of the TDS. The sulfide and ammonia concentrations showed variations in daily weekday and weekend trends. Sulfide levels decreased over the weekend, indicating a reduced input from industries. On the other hand the ammonia showed no difference between weekday and weekend. A large difference between the acidity and alkalinity was found in all the samples analysed. On the basis of this difference and charge balance calculations it was concluded that this is due to the presence of organic bases in the wastewater. Multivariate data analysis was employed for the analysis of the sewage data, demonstrating the relationship between TDS and major ions. Heavy metals were found to have higher concentrations on weekdays than on weekends, indicating the presence of more industrial pollutants.

The information obtained in this present study has provided background information for further investigations in this project and other studies currently being undertaken by CWW. Alternative strategies for the reduction of TDS at the Western Treatment Plant are currently being evaluated. This postgraduate project is due to be completed in late 2006.

Projects through the School of Civil and Chemical Engineering

Final Year Projects

Trade Waste and Water Management at a Carpet Printing Plant (Jazayeri) - supervised by Dr Felicity Roddick

A carpet printing plant in the Western region of Melbourne sought some options to reduce its TDS discharge to Trade Waste. The aims were to investigate the volume and TDS loads of the various waste streams, to determine the opportunities for TDS reduction and water recycle, and to determine the cause of the drop in p H from 7 to 5 in the mixed waste stream on storage prior to discharge.

The first task was to gain an understanding of the carpet printing process and to determine the TDS contents of the various streams. There are two printer lines with slightly different configurations, the more complex process gives rise to six waste streams: an initial carpet rinse, two rinses after screen printing, two rinses after application of a stain resistant agent, as well as a printing screen wash. The highest TDS level occurred in the first post-printing rinse stream, those of the other rinse streams were only 3-10% of that level. Consequently, it was recommended that the first rinse stream be kept separate from the others, and a range of suitable processes was suggested for the treatment of this now high concentration/low volume stream. It was also recommended that the other rinse streams be considered for recycle within the process, with or without pretreatment. Potential savings of up to 48 and 67 kL water per day for each of the two printer lines, respectively, are possible on implementation of these recommendations.

The combined waste stream is neutralised with alkali prior to discharge as Trade Waste. Occasionally it is stored for 2-3 days prior to discharge and over this period the pH falls from 7 to 5, necessitating further alkali addition (thus leading to higher TDS) before release. A thickener, a natural polymer of glucose, is used in the printing process and is largely removed in the first post-printing rinse. Analysis of the combined waste steam showed that the viscosity decreased by approximately 20% and the glucose concentration increased over the storage period. Furthermore, three different species of bacteria were isolated. It was concluded that the bacteria degraded the thickener and metabolised the resultant glucose to acidic products, causing the pH to drop.

Trade Waste and Water Resource Management Plan for Edible Oil processing plant (Azzam El Hawli) - supervised by Dr John Harris

This project was part of the development of a trade waste and water resources management plan for a facility consisting of rendering of animal fats, refining of edible oils and margarine production. The specific project was to perform a water balance and sodium balance for the site, and following from this a cleaner production (CP) study to identify opportunities for the reduction of water and chemical usage within the complex.

The first task was to reduce the differences in the water balance for the site. It was found that the water lost by evaporation and leakage from the cooling towers had been underestimated, but that the amount of water in the finished product was less than the previous figure. The difference in the water balance between total input and total output was 6.4% which was considered satisfactory as water for bathroom facilities, toilet flushing and irrigation had not been included. The CP study suggested stopping the leakage from the cooling towers, and the reuse of CIP water for truck and floor washing purposes.

In conducting a sodium balance, sampling results from the main pit showed that the TDS concentration varied fourfold. Using a time-averaged figure the sodium mass balance had a difference of 5.6% which was considered as close as could be expected. The major source of sodium ions was from the caustic soda used for pH adjustment in the DAF waste treatment system. Although the PID feedback control produced an average pH of 6.3, the pH fluctuated from 4-10 with corresponding fluctuations in the daily use of caustic soda. The cleaner production proposal to reduce caustic usage in the DAF was to install cascade control and a variable speed pump to replace the PID feedback control. This would even out the fluctuations in the pH and caustic usage. These results and recommendations were presented to the company management and CWW representatives.

Conclusion

The collaboration with CWW in Applied Science and Engineering programs at RMIT has provided students with the opportunities to be involved in real projects and work extensively with industry, consultants and a range of external agencies relevant to the projects. The projects also assist our students to become job-ready graduates and this has significant bearing on their initial entry into the environment profession.

The outcomes of each of these projects demonstrates how effectively student projects can be integrated into the normal operations of an industry with significant benefits for the students involved, the companies, the water authority and the environment - truly a 'win-win-win-win' outcome!

The Author

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CONTENTS

Our Cover: Water treatment technologist, Sandy McGregor, conducts a jar test at a WTP.

WIOA - WHERE TO FROM HERE?

On reflection of the 2005 year as it draws to a close, it is true to say that there were a number of ground breaking developments for WIOA. After an extended period of discussions with AWA about how we could develop a more cooperative and inclusive working relationship, 2005 saw some huge steps forward in this regard. We have now reached a point where there is a fundamental recognition of WIOA, our goals and services offered, and our importance as a key organisation in the national water industry structure. We hope to quickly finalise the few remaining issues with AWA and then work on further consolidating our position on the national front.

For just over 30 years, WIOA and its predecessor bodies have been totally reliant on the work of a band of committed and enthusiastic volunteers. The appointment of our first ever full time employee in 2005 was a big change to this philosophy. Fundamentally though, the role of the Executive Officer is not to replace the volunteers and do ALL the work. It must be a coordination role designed with the intent of identifying and growing a strong supporter base in each State to assist with the development and delivery of the multitude of activities we intend to offer.

Before I charge off into telling you specifically what we want to do, I'd like to try to summarise the essence of what WIOA is about in a few sentences. We are primarily about raising the profile and importance of that group of people we collectively call "operators". We aim to source, develop and share knowledge and resources with them and to run informative events with an operator flavour. We want to give opportunities to operators to allow them to reach their true potential and we want to make sure that access to the best and most relevant training is readily available. Ultimately, we want to be a group that people are proud to be associated with.

George Wall is the Executive Officer of WIOA and can be contacted on telephone 0358 216 774, mobile on 0407 846 001 or by e-mail on george@wioa.org.au.

So exactly what is it that WIOA intends to achieve in the 2006 year and beyond?

- **State Groups** - Development and consolidation of a state based support network and working committees to assist develop and deliver operator focussed services and events;
- **Conferences** - Delivery of successful operator conferences in Victoria, Queensland, NSW and having some level of involvement with the SA event. It is intended that the Queensland and New South Wales events will develop into a similar size and scale as the Victorian event. We will also investigate what can be done in the other States and Territories to allow for future events;

We are primarily about raising the profile and importance of that group of people we collectively call "operators". We aim to source, develop and share knowledge and resources with them and to run informative events with an operator flavour. We want to give opportunities to operators to allow them to reach their true potential and we want to make sure that access to the best and most relevant training is readily available. Ultimately, we want to be a group that people are proud to be associated with.

• **Membership** - In conjunction with AWA, promote the benefits and services on offer to members of WIOA, with the intention of further growing the membership numbers of both organisations in all states. Membership of WIOA costs $15 per year and includes all current publications, access to technical and training resources, opportunities to attend low-cost operator seminars and events, and access to the WIOA member and expertise network;

• **Seminars** - Development and delivery of specifically targeted seminars in each state. Topics likely to be covered include water distribution system operational issues and filter maintenance for a start;

• **Communications** - Consolidation of our communication systems with members and the water industry in general through the quarterly Operator newsletter, our monthly e-news, the *WaterWorks* journal, and our website. The WIOA website will be revamped to reflect our new national structure with the addition of new operator-friendly services;

• **Technical Resources** - Investigation into the development, publication and distribution of operationally based technical materials and case studies;

• **Training** - Continued involvement with the Water Industry Training Package review, and if or where appropriate, the development of training resources;

• **Licensing/Registration** - Investigation into the potential for "Licensing" or "Registration" for operators of particular systems. Although this idea has been on our "like to do list" for many years, it has been left in the "too hard" basket. Responsibility for this task was assigned to WIOA at the AWA/WSAA training meeting held in Sydney in 2005 and the initial investigation has been brought forward on our priority list;

• **Operator Exchange** - Following on from the success of the 2005 pilot exchange with NZ, the concept will be further refined for 2006 and beyond;

• **National Awards** - For many years each state has offered a variety of awards but all with different qualification rules and varying levels of importance attached. We will look at standardisation of these awards nationally. This would then allow the judging of the state based winners against each other in each category to come up with a national winner.

To achieve all this, we need to work proactively with AWA and various other water industry associations and interest groups to develop mutually beneficial and inclusive events. We need to ensure that we are not reinventing the wheel, or duplicating services and resource development.

Most importantly though, we need all members to get active and contribute to the workings of the Association whenever possible. If you get the opportunity, make sure you attend events or get involved by letting us know what it is you are doing in your workplace. Keep in mind that we would be only too pleased to help you develop an idea or assist you to write up an article if you need some help.

If you would like more information on WIOA or what we are all about, please contact me or visit our website at www.wioa.org.au

George Wall

WATER QUALITY AND DISTRIBUTION SYSTEM SEMINAR

Anthony Evans

On the 21st July, the WIOA staged its second Water Quality and Distribution Systems Management Seminar aimed specifically at distribution system operators and issues relating to operation and maintenance of the system. The particular emphasis was on the maintenance of water quality throughout the distribution system. The seminar was convened in response to demand from WIOA members, as well as to meet needs identified in discussion with various water system managers and regulatory bodies.

This year's event was held in Melbourne at the Sandown Park Hotel in Noble Park and was attended by 100 operators who travelled from as far away as Cairns, Sydney, Wagga Wagga, Temora and New Zealand. It was pleasing that almost every Victorian Water Authority was also represented.

Peter Mosse addresses the capacity audience.

Following the success of last year's event, and to cater to those not able to attend last year, a number of presentations were repeated. All the presenters were chosen carefully to ensure that they were skilled and knowledgeable people able to share their experiences with us. The presentations were required to be pitched at an operational level and to provide some concrete examples and advice on how to manage distribution systems. The aim for the day was to give all participants something to go out and start improving the operation of their distribution systems immediately.

The speakers included:

- **Peter Mosse** - (Gippsland Water/ Hydrological P/L) provided some background to the new environment for the management of drinking water quality with the publication of the new Australian Drinking Water Guidelines and the Victorian Safe Drinking Water Regulations.

Peter also talked about ways to monitor distribution system function including a simple system of mapping towns for chlorine residuals, taste and odours. A number of case studies of taste and odour and dirty water were presented.

- **Jill Busch** - (Gippsland Water) spoke about the importance of disinfection for effective pathogen control and how to maintain adequate disinfection within the distribution system. The advantages and disadvantages of different disinfectants were considered along with some real life examples of how things can go wrong within a system.
- **Neal Healey** - (Goulburn Valley Water) Tackled the difficult question of how to manage small work groups where staff are required to alternate duties between water and wastewater functions and still maintain the quality of the water in the distribution system.
- **John Hearn** - (South East Water) spoke about the role of operators in keeping a distribution system running well and showed us the cheapest colour and turbidity meter on the market - the white bucket.
- **Bob Muns** - (3M and RMS) emphasised the fact that distribution system management often requires work on roads and roadsides and the need to manage traffic safely. He spoke about road traffic control signs, how they should look along with an explanation of Australian Standards and the legal requirements for these signs.

Nick Hewer-Hewitt answers questions.

- **Bernd Vetter** - ("us" - Utility Services) provided a short explanation of pipe repair and then escorted everyone to the car park for a practical demonstration with the complete setup on his truck.
- **Dammika Vitanage** - (Sydney Water & the CRC for Water Quality and Treatment) discussed the advantages, disadvantages and costs of flushing, air scouring and swabbing a distribution system and provided some case studies to support these findings. Dammika clearly showed the advantages of maintaining a clean distribution system
- Last but not least **Nick Hewer-Hewitt** - (NZ Environmental Training Centre) explained how things work in New Zealand and discussed some of the major differences in system operations. Nick also provided some lovely photos of what can be found in pipe systems.

Once again the day proved to be a resounding success and we have been provided with some great ideas for next year thanks to everyone that filled out the evaluation form. It was amazing to see people from interstate and overseas in only our second year and we will now work hard to be bigger and better next year. There is scope to run this type of event in other states as well, so if anyone is interested contact George Wall at info@wioa.org.au.

The Author

Anthony Evans (anthony.evans@wrwa.com.au) is an operator employed by Wannon Region Water Authority in Warrnambool.

NEW ZEALAND VISITED

Jarrah Feather

At the 2005 WIOA Victorian conference I was awarded the best paper by an operator for a paper I presented on a workplace hazard. The prize for this award is $1,000 (sponsored by Actizyme) and usually a trip to the 2005 NSW Conference to present the paper again. However the WIOA had other exciting plans and decided to send me, with financial assistance from the IWA to Auckland, New Zealand to the annual NZWWA Conference.

The planning of the trip was coordinated by George Wall with all flights, transfers, accommodation and conference registration arranged in advance. As far as I knew I was to meet up with the WIOA Committee person Anthony Evans before we flew out. We were then supposed to catch up with Brendan Holt from Gippsland Water who was due to fly with us to NZ to begin his Operator exchange placement doing water treatment for a couple of weeks.

Unfortunately Anthony and I were unable to locate Brendan before the plane flew out so we were left to wonder if he had actually made it or not.

Once in Auckland I relocated Anthony, who had managed to find Brendan on the plane on the way over. The next step was not so simple. As the Kiwi's are very suspicious of Australian natives, all three of us were subject to a curious sniffer dog. Anthony and Brendan got through unscathed however I was not so lucky, the dog took one wiff of my bag, sat down and added half an hour to my progression through NZ customs. Fortunately for me the lady with the rubber glove was quite gentle.

After the Customs incident we were met by Gil Miers from WaterCare, a WIOA Member from NZ who proceeded to take us on a tour of the Mangere WWTP, Auckland's main wastewater treatment plant, which might I add is quite impressive compared to my local treatment plant.

We checked in at our hotel and headed off to the conference welcome reception where we met up with Dave Neru, our official host for the trip. After an opening address from the president of the NZWWA and a few drinks, we proceeded onto a Mexican restaurant with the OPUS crew for dinner and drinks and a bit of an international discussion on water and wastewater issues, and heaps of other things not relating to the water industry at all.

The first day of the conference was taken up listening to technical papers and looking over the trade displays. The paper I most enjoyed on the first day discussed the replacement of existing pipelines using trenchless pipe bursting. This paper gave me an insight into another way to potentially reduce the salinity issues we are facing at East Gippsland Water.

That evening, we met up with Tony Hourigan who had invited us to join the Alldos crew for dinner at an Argentine restaurant located on the wharf.

Early on day two we went up the Sky Tower, complete with glass floor for a great view of Auckland city. It was then off to the conference for more papers, exhibition viewing and meeting countless of our NZ counterparts. That night we went to the official OPUS dinner that was held at a seafood restaurant located on the harbour.

The final day of the conference provided the highlight of the conference papers for me. The paper was on the development of a stream current powered water pump which may not sound terribly interesting but it was all about the authors experiences in Kyrgystan. He went to Kyrgystan to install a water system for people who had no means of supplying themselves with potable or irrigation water. The water pumping system was ingenious, using the current of the stream to power the pump and to increase the velocity of the stream. He also used a very effective method of passing on his information by incorporating a lot of real life pictures from Kyrgystan and the pumping system.

The conference over, Anthony and I headed to the Airport and headed for home.

Many thanks to East Gippsland Water for allowing me the time for this trip, IWA for the sponsorship, WIOA for coming up with the idea and sorting out all the details, OPUS and Alldos for their kind generosity and time, and everyone we met in NZ for looking after us so well and making us welcome.

Water Industry Training Package Review

The Water Industry Training Package was originally developed by the water industry and is therefore owned by the water industry. Due to constant changes in circumstances and technology within the water industry, this Training Package is now in need of updating if it is to remain relevant to the ongoing training and skill needs of the water industry and its workforce. The project to redevelop and enhance the Training Package has commenced and the first Steering Committee meeting was held in Melbourne on 7th October.

Government Skills Australia (the Government and Community Safety Industry Skills Council) has contracted the undertaking of this project to Australian Local Government Training (ALGT) who also managed the first stage of this review.

ALGT are now enlisting the support of water industry experts nationwide to provide technical knowledge across a range of specialist areas through the establishment of a number of Industry Advisory Groups (IAG's) in the following areas:

- Trade Waste;
- Water Treatment;
- Waste Water Treatment;
- Water Distribution;
- Hydrography
- Water Catchment
- Distribution.

The role of each IAG is to review and provide appropriate technical comment on the unit of competency for each of their areas of expertise. It is planned for the majority of this work to be e-mail or website based.

Water industry experts can register their expression of interest to join an Industry Advisory Group by visiting the Australian Local Government Training website at www.algt.com.au and downloading a registration form.

National consultation workshops will be scheduled for early 2006. For updates on a schedule of events and the status of this project, it is recommended that you frequently visit the ALGT website: www.algt.com.au

For further information on this important project, contact Joan Whelan, at ALGT on 03 9349 3911 or Email: joan@algt.com.au

KWATYE PRIZE 2005: COLOUR REMOVAL WITHOUT CHEMICAL ADDITION

Eddy Ostarcevic

The Kwatye (Water) Prize provides an opportunity for WIOA members to investigate an area of interest that has the potential to benefit the water industry. As a WIOA member for many years I decided to apply for the prize to study an area of water treatment that is of particular interest to me, the area of membrane technology and in particular nanofiltration. So with considerable surprise I was awarded the prize at the Victorian Operators and Engineers Conference last month.

So what are my plans??

With the prize money, and considerable help from Grampians Wimmera Mallee Water (GWMWater) I plan to visit a number of membrane plants in Europe, Scotland, Scandinavia and USA to study the application of nanofiltration. The field trip is scheduled to start in mid February with a return to Australia in late March.

Soft coloured water supplies usually require chemical treatment to convert the dissolved organic carbon (DOC) into a flocc so that it can then be removed. Low alkalinity waters require pH correction to ensure that coagulation and flocculation is optimised. However no matter how well the water is preconditioned and coagulated, a recalcitrant portion of the DOC will remain in the water. This remaining DOC is available to react with disinfectants to form DBPs, and can affect the taste and odour of the treated water directly or indirectly as a result of their interaction with chlorine.

GWMWater, like many water authorities, has undertaken extensive community consultation and the key message from our customers is that they want to reduce or eliminate the use of chemicals in the treatment of their water.

The advent of nanofiltration (NF) and 'tight' ultrafiltration (UF) membranes provides water authorities with a new set of tools to remove colour from soft water without the need to chemically treat the water, and at the same time provide superior water quality.

UF or NF membranes can significantly reduce the precursors to DBP production thereby reducing the disinfectant dose necessary to maintain a residual concentration to protect customers. Removal of DOC also serves to minimise the growth of biofilms in distribution networks by limiting the food available. Reduced biofilm growth equates to better water quality and a reduction in maintenance activities within the distribution system.

Membranes are able to remove bacteria, viruses and protozoa far more effectively than 'conventional' water treatment. This further reduces the risk of water borne disease transmission.

A further advantage of using membranes without chemicals is a reduction in the quantity of inorganic sludge generated by 'conventional' water treatment process. Inorganic sludge generally poses a disposal problem and if applied to soil it can lock up soil phosphorus and make it unavailable to plants so broad acre applications are severely limited. The concentrated organic material generated using membrane processes may have some potential as a soil conditioner thereby reversing the trend of disposal to that of beneficial reuse.

A number of membrane manufacturers including Hydranautics, Koch Membranes and Dow FilmTec have all developed membranes capable of removing dissolved organic carbon from raw water. The questions that require further study to determine what applications suit these membranes best include:

- What recovery rate is sustainable for UF and NF using different DOC sources such as that typically found in Tasmania, tropical north Queensland and the Northern Territory and the mountain regions of Victoria and NSW.
- Can NF and UF membrane system operate with recovery rates as high as 90%?
- Can increasing raw water temperature enhance DOC removal?
- What type of fouling problems will be generated and what cleaning procedures are required?
- Will these membranes be subject to increased microbial fouling because of the concentrated food source available?
- What are the limitations in water quality with respect to the types of DOC and alkalinity concentrations as well as calcium hardness?
- Can the concentrated DOC be used as a soil conditioner when the raw water supply is soft? Can this equally apply to hard coloured water sources?

Answers to the questions raised in this application are currently being sought from the membrane manufacturers in California. Site visits of operating UF and NF processes designed for colour removal are currently being arranged in Scotland, France, Norway and Florida. One particular process operating at Irvine Ranch in Orange County claims an operating recovery of 95% and extraordinary DOC removal.

Another large scale application provides treated water to over 800,000 people in northern Paris from the Méry-sur-Oise nanofiltration plant. Raw water is harvested from the Oise River that is described as polluted. The plant operations group has modified and developed a cleaning program that maintains membrane performance so it will be interesting to see the progress they have made.

The new UF plants installed to supply Mosman in far north Queensland have recently been commissioned and direct operating experienced should be available at this stage. These sources should be able to provide specific operational knowledge and help develop this process in Australia.

The Kwatye Prize generously sponsored by **Environmental & Process Technologies (Division of Biolab)** has provided me with a unique opportunity to investigate my area of interest and return some of this knowledge to the Australian water industry. You too could have this opportunity of a lifetime if you win the prize next year. So why not enter. You never know you just might win.

The Author

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A NEW ZEALAND EXPERIENCE

Brendan Holt

Report on the Water Industry Operators Association International Operator Exchange to New Zealand

This year I was fortunate enough to travel to New Zealand and spend two weeks with the Palmerston North City Council (Water Treatment Group) as part of the International Operator Exchange Program. This exchange program was able to take place due a collaborated initiative between the Water Industry Operators Association (WIOA) and the New Zealand Water and Waste Association (NZWWA). This program was the first between these two organisations and the success of this exchange would determine the possibilities of future exchanges.

As this exchange was somewhat of a "trial", Gippsland Water was asked by WIOA, and agreed, to support one of its members in the program and to also play host to a NZ operator.

The exchange involved Wayne Brownie form NZ attending the WIOA conference held in early September and then spending two weeks with Gippsland Water. His time was spent travelling the many kilometres between all our sites and getting an idea of the varied Water Treatment Processes we use.

To complete the 2005 exchange, on the 27th October I crossed the "Ditch" and flew into Auckland. My itinerary was as follows:

- Spend three days attending the annual NZWWA conference in Auckland.
- Hire a car and spend the weekend making my way 650km south to Palmerston North.
- Live and work with my NZ host, and go on tours of the region's Water Treatment Facilities for the next 10 days.

NZWWA Conference: Enviro NZ 05

Accompanied by two other WIOA members, Anthony Evans (WIOA committee member) and Jarrah Feather (Winner of the IWA and Actizyme prizes for best paper by a WIOA member at the 2005 conference), I attended the NZWWA conference for 3 days. The NZWWA conference is equivalent to our Australian Water Association (AWA) conference. This conference covers much the same format as ours, with people presenting posters and technical papers, trade exhibitors and site tours.

Train tunnel through mountain.

Of interest was a presentation made on the Drinking Water Standards for New Zealand 2005 (DWSNZ). These standards come into effect on the 31st Dec 2005. This talk was of particular interest as our own Safe Drinking Water Regulations came into operation on 19th July 2005 under section 56 of the Safe Drinking Water Act 2003.

The DWSNZ is a 170 page document that includes sections on Water Quality Standards, Compliance and Transgressions, Bacterial-Protozoal-Chemical-Radiological and Cyanotoxin Compliance Criteria, Small Water and Tankered Drinking Water Supply Compliance Criteria and Sampling Requirements.

There are two measures used in defining drinking water standards:

1. Maximum Acceptable Values (MAV), used for specifying the maximum concentrations of microbial, chemical and radiological parameters that are acceptable for public health. These are the "yardstick" by which water's suitability for drinking is assessed.

2. Guideline Values (GV), used for determining a value which although not considered to be harmful to human health, does create aesthetic problems.

The NZ and Oz standards, seem in general terms to be quite similar. Some water quality standard values may differ slightly however both are based on the same basic requirement for a fully implemented Risk Management Plan.

The majority of NZ's water supplies are soft, with low levels of alkalinity and pH. This can lead to the leaching of metals such as lead from plumbing fixtures. The term used for this type of water is "plumbosolvent", meaning, able to dissolve lead. As a requirement from the Ministry of Health (who enforce the regulations), twice yearly each Water Authority has to provide each household with a public notice that states:

a. The water in the supply is mildly corrosive to plumbing fixtures and may accumulate metals of health concern if it lies for too long in the plumbing.

b. Before using the water for drinking, at least 500ml of water should be flushed from the tap and discarded to flush away these corrosion products.

The days at the conference were spent listening to many interesting technical paper presentations and making lots of NZ contacts. The nights involved tasting the odd drop of very fine local beer and discussing everything from the weather, Aussie Rules Football, Rugby, the America's Cup and single lane bridges. A big thanks to the guys (and girls) of Opus International Consultants and Alldos who looked after us for these three nights.

Upper Turitea Dam.

At the conclusion of the conference, Anthony and Jarrah flew home and I made my way down to Palmerston North, which is approx. 150km North of Wellington. Here I stayed with Wayne Brownie (NZ exchange operator) and spent the next 10 days visiting 8 WTP's, gathering lots of information and taking many photos.

Site Visits

My intentions before heading over were to study NZ's water treatment practices, disinfection systems, distribution systems and their work groups. In particular, I was interested to learn of any processes, technologies or work practices that could be implemented at Gippsland Water.

During my time in NZ I visited eight Water Treatment Plants (WTP) ranging in size from 1ML/d to 300 ML/d. My report will focus on the ones in which I spent the majority of time and those which I consider to have been the most interesting or different. The WTP's included Ardmore, Turitea, Ashurst, Wakanae, Pakakariki, Wainuiomata, Kaipatangata, Greytown-Featherston and Fielding.

Ardmore WTP - Ardmore WTP was the only WTP I visited whilst in Auckland. Ardmore WTP accounts for approx. 70% of Auckland's treated water supply. It has

Wayne Brownie (left) and Brendan Holt, exchange operators.

the option of drawing water from four dams in its catchment and via gravity is fed through clarifiers into 30 rapid sand filters. It is a conventional WTP on a very large scale. The use of an on-site sodium hypochlorite generator is due to the large volumes of hypo that would need to be delivered and this is uneconomical. The WTP is run by 5 operators who carry out routine testing, process monitoring and maintenance tasks. It has recently had a $25M upgrade focusing on refurbishing filters, air scour and backwashing facilities and improving on-site sludge handling.

Wainuiomata WTP - Wainuiomata WTP forms part of the Wellington Water Supply Network consisting of four WTPs, 15 pumping stations and an ever growing population of 33 treated water reservoirs. The Wellington network has a total system demand that ranges from 150ML/d to 350ML/d. Wainuiomata has a design capacity of 60ML/d, although generally is producing approximately half this amount. It can draw raw water from three sources depending on their condition. One of these intakes is accessed by a diesel engine train that travels 3km through a mountain tunnel. Although this catchment had been supplying water since the early 1900's, a conventional WTP using dissolved air flotation filtration (DAFF) was only built in 1993. Located at the WTP are 3 operators who complete all Mech/Elec maintenance tasks themselves. This was also the only WTP I visited where Carbon Dioxide was used to raise the alkalinity of the raw water.

No expense seemed to have been spared in regard to control instrumentation, as in addition to "standard" on-line instruments they had two Streaming Current Detectors (one used as a backup), three continuous colour monitors, double backup pH probes for coagulation setpoint control and three new "S:CAN" analysers that were about to be commissioned. These analysers can monitor various water parameters continuously at the same time eg. TOC/DOC. They have installed a sophisticated PLC and SCADA system from which they can control any process in the network under their responsibility.

During my time there the WTP was off and had been for 8 weeks. This was due to the fact that the poison "1080" had been dropped in the catchment to eradicate the local possum population. This seems to be a consistent approach across NZ with possums being in plague proportions. Possums are not native to NZ.

How can a WTP be off for 8 weeks? The answer is that they are able to utilise a number of bores situated in the network. Whilst the WTP has been off two bores have been running, feeding directly into the distribution system. This bore water is untreated and does not receive disinfection. The Ministry of Health are satisfied that the aquifers used are of a high quality and that the water is more than 12 months old by the time it is pumped out and sampling requirements have indicated that there are no health concerns associated with its use. Sampling, however, is still carried out routinely.

Due to the large supply demand that the network experiences, no disinfection sites are necessary along the line as the water is only in the system for 24 hours. A chlorine residual of 0.6 mg/L leaving the WTP is enough to maintain at least a 0.2 mg/L at the extremities of the system.

Turitea WTP - Turitea WTP is operated by the Palmerston North City Council where I was located. It has a population of 65,000 people. The WTP obtains its raw water supply from a dam constructed on the Turitea river. The raw water is of a consistent high quality that averages around 2.5 NTU. The

plant typically operates at 30 to 40 ML/d and consists of a gravity fed clarifier system that then feeds eight rapid sand filters. Sludge generated by the clarifiers and during the filter backwash sequence is passed through a "lamella" which acts like a clarifier and separates the solids from the liquid. The supernatant is monitored for turbidity and if it is below 5 NTU is pumped downstream into the river. The polymer thickened sludge is then passed through the sewer system to the WWTP. There are four bore stations in town that help supplement the reticulation during high flow periods. They start automatically when the pressure in the system falls below a pre-determined setpoint. This water is untreated, only dosed with chlorine gas and fluorosilicic acid (fluoride). The WTP and all bore stations have a permanent backup generator on-site that is run monthly to ensure correct operation. Installed at the upper dam where the raw water off-take is, is a mini hydro power station that was designed to make the WTP self sufficient in energy usage. Any surplus energy is directed into the power supply network and over the course of a year is enough to power 100 homes.

On-site there are two operators and a supervisor who share rostered on-call duties along with the normal WTP duties. They carry pagers to receive alarms from the plant and also have remote SCADA access and control of the WTP from their homes.

Some General Observations On NZ WTPs

In general the NZ raw water is of a very good quality. Many of the WTP's are situated in Council owned, protected catchments and their design capacity is upwards of 30ML/d. To accommodate total system demand, many Councils use bore water to supply the reticulation. NZ has a wealth of good quality aquifers and it is not uncommon for a system to have several bore stations throughout the city. The groundwater source is also important because the amount of water that can be taken from a surface source is limited by the Natural Environmental Flow restrictions. Due to the number of bores and the good quality water, when the raw water from the reservoirs exceeds 4 -5 NTU it is uneconomical for them to run the WTP so they are turned off until the reservoirs come clean.

Most WTP's use conventional processes such as rapid sand filtration and dissolved air flotation filtration, however some smaller facilities were opting for micro-filtration using either synthetic fibre filter tubes or filter bags rated at anywhere between 1-35 micron. Using these filters meant there was no need for chemical treatment of the raw water. However the bags/filters have to be replaced periodically. Only systems with consistently good raw water quality use bags/filters.

Also noted was the reluctance of Councils to return their supernatant water to the raw water for fear of contaminating the water with protozoa such as *Cryptosporidium* and *Giardia*. Most sites were also mindful of the filter ripening period after a backwash and actually dumped this water until the turbidity was down to 0.10 NTU. At some WTP's this water was held in a purpose built tank then returned to the start of the plant, and at others it was sent to the sludge facilities.

Many WTP's had not yet covered their filters and as a result had to pre-dose sodium hypochlorite to the filters to prevent algal growth. This task was generally completed every 6-8 weeks for two weeks at a time. I had also noticed that most Councils had opted for poly aluminum chloride (PAC) as a coagulant to inhibit problems caused by low alkalinity and pH of the raw water.

A few other practices that I noticed as a common theme was the beginning of a manganese removal plan at several sites. One site was dosing potassium permanganate then using an aeration tank prior to the clarifier. This unit was in construction phase and had not been commissioned. Another site that had been running for 12 months dosed the bore water with sodium hypochlorite to oxidise the manganese, then ran the water through a pressure filter consisting of synthetic fibre filter tubes rated at 5 micron. This proved very effective, but expensive. To replace the filters each year cost approx. $20k for materials only.

The security surrounding some of the sites also made me see where some of our sites might be in the next few years. WTP's had electronic key card access gates; electric fencing, security fencing and CCTV cameras covering the site with a monitor in the WTP office.

Some councils were well under way in beginning active water conservation activities by means of pamphlets and television commercials.

Conclusion

Overall I benefited greatly from this experience and came back with a lot of ideas and initiatives that I hope can be implemented at Gippsland Water. I have made a lot of contacts and friends with whom I can now share information. I urge anyone who has the opportunity to participate in this operator exchange program to take it up. I assure you that you will treasure the experience.

I must thank the following people and organisations who have made this trip possible and enjoyable for me: Water Industry Operators Association (WIOA); New Zealand Water & Waste Association (NZWWA); Gippsland Water; George Wall (WIOA Executive Officer); Ian Soutar (Gippsland Water, Water Treatment Manager); Russell Mack (Gippsland Water, WIOA Committee Member); Anthony Evans (NZ Tour Partner, WIOA Committee Member); Jarrah Feather (NZ Tour Partner); Dave Neru (Opus International Consultants, NZWWA delegate); Opus International; Alldos; Palmerston North City Council; and Wayne Brownie (Palmerston North City Council, Water Treatment Operator).

The Author

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SEWER PUMP STATION FALL PREVENTION SYSTEM

Jarrah Feather
Judged Best Operator Paper at the Annual Victorian Water Industry Engineers and Operators Conference 2005

Introduction

Every year, the risks involved in the transfer and treatment of wastewater are demonstrated by the number of reported workplace injuries and health related issues. These incidents range from minor infections, to more serious things such as deaths in confined spaces and falls from heights.

The Victorian Occupational Health and Safety Regulations (Prevention of Falls) 2003 have highlighted the need for the water industry to alter the way it carries out work at heights. Falls from heights have always been an inherent risk when working around sewer pump stations, especially during confined space entries, station inspections and pump station maintenance. Fall arrest devices, gas detection equipment, stringent training and comprehensive procedures have significantly reduced the accidents associated with this hazard, However it is only now that the standby person, the person standing atop a drop of over 2 metres monitoring those below is accounted for in the risk assessment. Although the standby person will not be entering the pumping station wet well, he or she faces the enormous risk of falling into a well filled with dangerous and fouled components.

This is part of the reason why Worksafe Victoria has introduced its new regulations outlining the obligations employers have in providing employees safe workplaces around fall hazards.

East Gippsland Water, in collaboration with Kennedy's Aluminium Pty Ltd has researched and developed a system designed to eliminate the risks associated with working at heights around sewer pump stations. EGW have a long and mutually beneficial relationship with Kennedy's.

The Prototype

While sewer pump stations can be quite different there were sufficient similarities to allow the design for the prototype. All stations were over 2 metres deep, which means that they needed some type of fall protection system incorporated into their structure. The fall protection system needed to be easily retrofitted to existing stations, and from an operations point of view, be simple and easy to erect and use.

Figure 1. Aluminium corner bracket.

The basic concept of the prototype was to install a grate directly beneath the hinged aluminium lid. The grate had to be lightweight, to avoid manual handling problems, completely removable and be constructed out of mesh to allow visual inspection of the station components located below. The prototype design also had to incorporate a bracket to hold the grate in place and include a sleeve to insert a handrail system into.

Stage one of the manufacture involved the fabrication of corner brackets to allow the grate to be attached to the floating slab beneath the access hatch (Figure 1).

Stage two was the manufacture of the grate. These were designed to fit onto the corner brackets. The grates have a maximum weight of 20kg (two-person lift), and in combination with the corner brackets are rated at 5 kPa (500kg live weight per square metre).

The handrail system was the final component of the project, and from an operational point of view, the most important. The initial concept of the system was simple; however the design was made more difficult due to the difference in size of the access hatches. The final solution was to make the handrails self retracting telescopic tubes. The entire system consists of three sets of four different length handrails, and four posts. The handrails length varies from

Figure 2. Handrail system - quick action clasper attached to post.

0.56m to 3.4m depending on the application. The rails are telescopic and have quick action claspers to allow their fitting to a wide range of well sizes and ease of use (Figure 2). The handrails are erected in much the same way as a scaffold, the whole process taking less than 90 seconds. The fully assembled system is shown in (Figure 3). If there is need for somebody or something to enter or exit the erected system, partial removal of one or more of the handrails (Figure 4) allows this to occur, with no risk to the operator.

Since the handrail system is portable, there is no need for each system to have a dedicated rail system. Consequently EGW have developed the system so that two sets of rails are maintained in each Depot at EGW.

The system has been designed so that the grate and brackets are totally hidden below the wet well lid and the barricading is completely removable, allowing for areas where aesthetics are important.

Worksafe Victoria has approved the system as a fall prevention risk control and commended EGW for its innovation in risk management.

Evaluation of the Prototype

A prototype was installed and evaluated. The system needed to be improved to allow the grate to be lifted out of the erected handrail system without dropping it and without introducing manual handling problems.

Figure 3. Fully installed handrail system with grate removed.

The introduction of an aluminium hook for removing the grate out helped with the bad ergonomics previously encountered and removed any manual handling risks associated with the task. This allowed the grate to be lifted to one end and then removed by two people from outside of the erected handrails. A snap lock hook, attached to a length of stainless steel cable, and incorporated into a corner bracket is now attached to every grate. This is manufactured at a length of 0.70 metres and designed to allow the grate to fall a short distance without damaging essential electrical components located inside the well.

Figure 4. Practical use of the handrail system - removing pump.

Full Scale Installation

With the modified prototype installed and proven operationally, it was then time to begin the task of installing the system in as many stations as possible.

A bulk order of corner brackets was placed. These were installed and the dimensions for the grates accurately measured. Once these had been manufactured they were installed under the station lid atop the preinstalled corner brackets. Thus far in the Bairnsdale region alone, we have been able to successfully install the complete system in 68% of our sewer pump stations. Of the remaining stations, 15% have had a secondary somewhat simplified system installed.

Figure 4 shows the system in use during the lifting of a submersible pump.

Costs

The cost to research and develop the system, including the manufacture and installation of the prototype was estimated at $14,000. EGW has budgeted $190,000 over three years to manufacture and install the system in up to 90 stations, which equates to around $2,100 per station.

Acknowledgments

Thanks to Tony Smith (HSSC), Tim Froud (Works Superintendent) and Gavin Overy (Operator) from EGW, and to the staff of Kennedy's Aluminium for their hard work in developing the effective fall protection system.

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RECYCLED WATER PRODUCTION AT ROUSE HILL

Iain Fairbairn

Judged Joint Best Paper at the AWA NSW Operators Conference, September 2005

Introduction

Rouse Hill Recycled Water Treatment Plant (RWP) is located in Sydney's North West Sector, one of the fastest developing areas in Australia. Treated wastewater generated from the development area could not be effectively discharged to the environment due to the sensitive local waterways. The load on these waterways had to be kept to a minimum. The Rouse Hill system was therefore designed to return some of the treated effluent back to the residents for outdoor use (irrigation, car washing) and toilet flushing as one of the earliest and largest residential re-use systems in Australia.

To ensure community acceptance and to protect public health, Sydney Water has established a multi-barrier approach to recycled water treatment. The inclusion of ozonation and continuous micro-filtration were additional to the requirements set by the NSW Recycled Water Guidelines.

Rouse Hill RWP was commissioned in 1994 with inflow around 500kL/day. The recycled water supply was commissioned using potable water at that time, as there was not enough wastewater entering the plant to warrant building the additional recycled water process units.

By the late 1990's, inflow to the Rouse Hill RWP had increased from 1 ML/day to 8ML/d as a result of increased urban development. In 2001, the recycled water process units were commissioned and houses supplied with recycled water for the first time.

The incoming wastewater is first treated in a biological nutrient removal activated sludge plant. Effluent from this plant then undergoes full tertiary treatment with aluminium sulphate coagulation, flocculation and filtration to remove the remaining phosphate and suspended solids. Effluent leaving the tertiary filters is pumped to the RWP for further treatment. The recycled water process initially consisted of Ozonation, Continuous Micro-filtration and Super-chlorination.

Biological reactor.

From 2001 until 2003, recycled water production from Rouse Hill was not reliable. Most of the downtime was associated with the ozonation facility. Since the plant relied on ozonation for inactivation of *Cryptosporidium,* the system was designed such that any failures of the ozonation facility would automatically shut down the production of recycled water.

The majority of the water is recycled, however during peak flow and at times of low recycled water demand (wet weather, winter) some effluent is disinfected and discharged to the local waterway via a series of constructed wetlands.

Due to the continued problems with the ozone generator, it was decided to seek approval from the NSW Department of Health to decommission the ozone disinfection process at Rouse Hill. A 30 day proving period was conducted in September 2003 to test the quality of the recycled water without the ozone process unit. The recycled water quality from Rouse Hill RWP continued to exceed the NSW Recycled Water Guidelines.

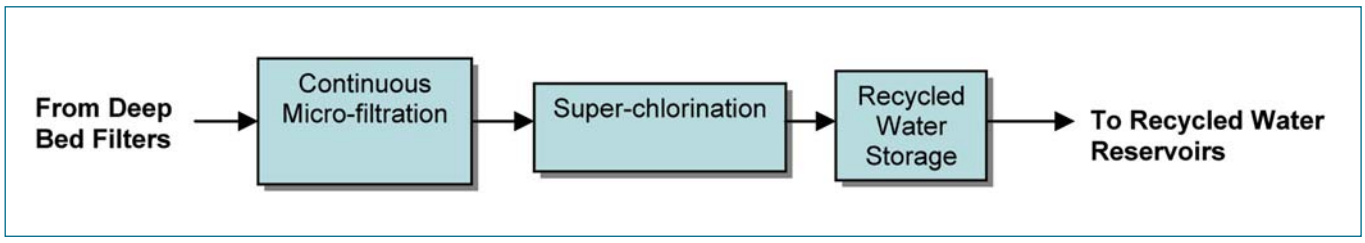

Figure 1. Recycled Water Treatment Process Train.

Recycled Water Production

Tertiary effluent is pumped to a 5ML/d continuous micro-filtration (CMF) facility that filters the water through 0.2um membranes. This physically removes suspended solids, parasites, pathogens and some viruses. The CMF plant can treat a maximum of 60L/s and is the current bottleneck in the supply of recycled water.

Filtrate from the CMF is super-chlorinated at a free chlorine residual of 6 - 7mg/L for 140 minutes prior to storage and transfer to the three elevated recycled water storages throughout the catchment.

Recycled water production at Rouse Hill is more than just adding on two additional treatment units. There are many special considerations that need to be addressed and incorporated into the operation of the sewage treatment system.

Plumbing Controls and Inspections

Ensuring that the recycled water supply does not contaminate the drinking water supply is a fundamental challenge in a dual reticulation system. Every effort has been made to clearly identify the recycled water pipelines and fittings. Houses in the area must be inspected and tested several times during the construction phase to ensure that recycled water is only used in toilets and special outdoor taps.

Even with rigorous testing, inspections and training of tradesmen and homeowners, there have been several occasions where cross-connections of the two water supplies have occurred. It is very difficult to totally mitigate this risk with over 30,000 properties in the development area and hundreds of houses under construction at any time. Sydney Water uses a multiple barrier approach to recycled water production to ensure that its recycled water product also meets the drinking water quality guidelines. This reduces the risk to our customers if they consume recycled water inadvertently.

Quality Sewage Feed

Sewage treatment plants can accept a wide variety of waste products from household sewage to industrial trade waste. Many sewage treatment plants are not able to treat industrial waste effectively and this could lead to contamination of the recycled water supply. Fortunately, the Rouse Hill catchment is predominately residential, which greatly reduces the risk of industrial waste entering the treatment plant.

Although the risk is low, the production team at Rouse Hill have developed an automatic response to this kind of trade waste entry by monitoring its effects on the biological process. If a large quantity of industrial waste entered the treatment plant it would normally cause some or all of the biomass to die. Without the biomass consuming dissolved oxygen (DO), the residual DO will increase sharply during the start of an aeration cycle.

Micro-filtration plant.

Some trade waste entries may contain an unusually high BOD load that will overwhelm the biological process. Under this condition, the residual DO concentration will remain very low even during extended aeration of the biomass.

Under these scenarios, feed to the recycled water plant is automatically isolated and a member of the production team is notified immediately to investigate the incident. Recycled water production will not commence until it is confirmed that the sewage treatment processes have returned to normal operation.

Normal variation in plant load can sometimes cause fluctuations in dissolved oxygen concentrations in the biological reactors. At low flow, over-aeration can lead to rapid increases in DO concentration and during high flow/load conditions, the DO concentration can be suppressed for extended periods. Careful management and optimisation of the intermittent aeration system has ensured that false alarms do not occur that would reduce the production of recycled water unnecessarily.

Management of Incoming Flows

Sewage treatment plants typically receive a diurnal pattern of inflow with distinct morning and evening peak flows. During the early morning (1am until 7am) there is often very little sewage entering the treatment plant. At Rouse Hill RWP this diurnal pattern was causing the intermittent shutdown of recycled water production, as it had no feed water. This reduced the total volume of recycled water produced each day from 5ML to around 4.3ML. In order to maintain 24hr production of recycled water, the inflow to the treatment plant must be maintained above 60L/s.

Through careful control of the inlet pumping station that supplies sewage to the plant, the capacity of the pumping station has been used to store sewage during the day and pump it into the plant in the early morning. This method has been useful in increasing recycled water production, but as development increases, the storage volume at the pumping station diminishes along with the effectiveness to balance flows. The risks of overflows from the pumping station also increases during power failures, as the wet well may be already full.

The ideal solution for recycled water plants is onsite storage of secondary or tertiary treated effluent that can be filled during peak flows and then used to maintain feed to the recycled water processes overnight.

Chemical Overdose Incidents

While Rouse Hill has been designed to operate with only minor chemical addition, it is possible that a chemical overdose incident could occur that would impact on

recycled water quality. Alum and Sodium Hydroxide (Caustic) are added during tertiary treatment and an overdose of either chemical would cause a decrease or increase in the pH of the tertiary effluent.

pH is monitored in four locations throughout the treatment process including the chamber where feed to the recycled water processes is withdrawn. If the pH is outside the acceptable range (6.5 - 8.0) then the supply to the recycled water plant is isolated and the production team is immediately notified. Recycled water production will not resume until the pH of the feed water is returned to the acceptable range.

This protection is in addition to the standard Sydney Water chemical dosing design that uses pressure sustaining valves, motorised ball valves and High/Low flow alarms to detect and prevent the overdosing or underdosing of chemicals.

Out of Specification Recycled Water

Due to process upsets or equipment failures, there are times when the recycled water product does not meet the acceptable criteria for free chlorine residual and turbidity. Water that does not meet the plant specifications is not permitted to enter the onsite recycled water storage tank. The production team has developed an automatic system that diverts the recycled water to the plant discharge disinfection tank and into the wetlands. Although the water does not meet the strict guidelines for recycled water use, it is acceptable to discharge to the receiving waters as part of the plants EPA licence.

The production team is notified when recycled water is being diverted and will attend to the incident. The recycled water product will not be directed to the storage tank until it meets the specifications for free chlorine and turbidity.

Ammonia Breakthrough from the Biological Reactors

Most sewage treatment plants have some breakthrough of ammonia during the peak loading of the biological process. This is especially true of treatment plants that maintain low residual DO and are optimised for Total Nitrogen reduction. This ammonia breakthrough can significantly impact the chlorination of recycled water and cause the product to be diverted to the plant discharge due to low free chlorine residual.

When the feed water to the super-chlorination process contains high ammonia (> 0.5mg/L), the addition of chlorine reacts with the ammonia to form chloramines. The free chlorine residual cannot be maintained even with increased chlorine dosing. This water must be diverted from the RW storage tank as the NSW Recycled Water Guidelines state that a free chlorine residual of at least 5 mg/L must be maintained for 60 minutes.

The Rouse Hill Production Team has established a creative aeration control system that automatically adjusts the intermittent aeration cycles and mixed liquor recycle (MLR) ratios based on timers and DO concentration. During low flow periods, aeration cycles automatically shorten to allow more anoxic time and more de-nitrification. When the load on the biological reactors is high, the aeration time is lengthened and aerator speeds are increased to provide full nitrification. The MLR ratio is automatically adjusted based on the DO in the aeration zone. The ratio increases when the DO is low to maximise nitrate return to the anoxic zone and when the DO is higher the MLR ratio is reduced to prevent the return of oxygen to the anoxic zones. This allows complete conversion of ammonia and also manages the biological treatment to achieve optimal reduction of Total Nitrogen.

Conclusion

While there is an increasing trend to recycle or reuse treated wastewater, there are many special considerations that must be addressed to ensure that risks to public health are minimised. This is especially true for dual reticulation schemes like the Rouse Hill development. Improper use of recycled water can still occur even with comprehensive plumbing inspections and education campaigns within the plumbing industry and for the general public.

The Rouse Hill Production Team has tailored the treatment of wastewater to ensure that its recycled water product meets both the NSW Recycled Water Guidelines and the National Drinking Water Quality Guidelines.

The team has also developed several automatic responses to conditions that threaten recycled water quality and protects the recycled water supply through isolation, diversion and 24hr notification to the production team. Recycled water production is much more than adding some additional disinfection processes onto an existing sewage treatment plant.

The adoption of a multiple barrier approach has ensured that many layers of protection exist both within the catchment and at the treatment plant to protect public health and ensure that acceptance of recycled water remains high throughout the community.

During the current drought, as potable water supplies diminish, the scheme has also taken on a second role, directly reducing the amount of potable water used in the Rouse Hill Development Area by 30%.

The Author

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Recycled Water Feed.

WATER TREATMENT ALLIANCE:
FILTER ASSESSMENT WORKSHOP AT HOBART WTP

Peter Mosse

The Water Treatment Alliance (WTA) is a continuous improvement program for the management and operation of Water Treatment Plants (WTP). The Alliance developed after the water quality incident in Milwaukee in 1993 when around 400,000 people became ill with cryptosporidiosis and 50 people died, and the later incident in Sydney in 1998 where it was reported that there were very high concentrations of *Cryptosporidium* and *Giardia* in the finished water. Although no one became ill or died it has been estimated that this "crisis" cost Sydney Water well over $43 M.

The WTA provides a structured way to assess the current operational characteristics of a WTP, identify any deficiencies, develop ways to overcome the deficiencies and prioritise the necessary work to improve the operation of the plant and to monitor that improvement. The steps are consistent with those described in the Australian Drinking Water Guidelines, Framework for the Management of Drinking Water Quality. The WTA also provides best practice targets for WTP operation. For example, best practice operation of media filters should result in water with a turbidity of <0.1 NTU at all times except for a ripening period with a maximum turbidity of <0.3 NTU for no longer than 15 minutes.

Thus the WTA provides a useful tool to assist those Water Authorities implementing the Framework.

The Filter Assessment and Optimisation Workshops are run over two days at a WTP. The aim of the workshop is to train operations staff in the principles of WTP filter assessments and optimisation and to carry out inspections of the filters at the plant.

The workshops develop the concept that WTPs are part of the system for the production of water, starting in the catchment and ending at the consumers tap.

Filters clearly represent a key control point in the production of safe drinking water, hence the importance of training Water Authority staff around Australia how to get the best out of their filters.

Workshop participants checking filter bed fluidisation during a filter backwash.

Workshop participants identify appropriate critical limits, target criteria and process monitoring for the filter control point. Appropriate instrumentation and record keeping, including SCADA trends are also discussed.

The workshops are designed to be "hands on" with all participants directly involved in the measurement and calculation of filtration, backwash and air scour rates.

Workshop participants hard at it calculating filtration and backwash rates from measurements made during filter backwashing.

Filter backwash profiles are constructed and filter run profiles investigated on the plant SCADA systems. Finally, full inspections of the media are carried out after entry to the filter is undertaken with appropriate OHS measures in place.

The first of these Filter Assessment and Optimisation Workshops was run at the Bryn Estyn WTP on October 26th and 27th. The treatment plant is owned and operated by Hobart Water and supplies water to the City of Hobart.

The workshop was attended by operations and management staff from Cradle Coast Water, Esk Water and Hobart Water.

Additional workshops are planned to be held at Winneke WTP in Victoria in late November and the Morgan WTP in South Australia in March. Two more workshops will also be run in Tasmania early next year. There are also plans to run workshops in New South Wales, Queensland and Western Australia.

So if you are interested in the WTA or the workshops why not find out more. Contact Peter Mosse at peter.mosse@gippswater.com.au or Peter Donlon at peter.donlon@wsaa.asn.au

FILTER OPTIMISATION AT WINNEKE

Mark Jarvis
Winner of the Hepburn Prize for Best Paper Overall at the Annual Victorian Water Industry Engineers and Operators Conference 2005

Background

The Winneke Water Treatment Plant (WTP) has a capacity of 450 ML/d and supplies up to 30% of Melbourne's drinking water. Commissioned in 1980, the plant is located north east of Melbourne, adjacent to Sugarloaf Reservoir.

Water is pumped from the reservoir to the inlet structure at Winneke, where it is dosed with lime and alum. A flocculant is used to aid clarification in four upflow solids contact chambers. Clarifier supernatant is filtered through 12 conventional rapid sand filters. Filtrate is pH corrected with lime and chlorinated, prior to entering the clear water storage. Treated water is distributed to the water supply system on a demand basis.

In recent times the Winneke Water Treatment Plant has regularly operated at flows greater than the design capacity. Efficient filtration and backwashing became essential, however filters were operating significantly below optimum.

A further driver for efficient filter operation was the current project of increasing Winneke's capacity to 620 ML/d. New filter design and operation is based on existing filters. Successful commissioning relies on established filters having an effective backwash sequence.

The filters at Winneke required a multi-pronged strategy of reform. One prong incorporated improvements to an inefficient backwash sequence. The second addressed media height differences on either side of the filter gullet. The third was to reduce media losses. The fourth was flow hunting. The final prong identified and rectified a number of other process improvements. As filtration involves a myriad of operating variables, optimisation was a compromise between conflicting target parameters.

Back to the Original Design

Backwash Sequence

The filter backwash sequence had over many years strayed significantly from the original design sequence. The sequence that was in use is outlined in Table 1.

Table 1. Existing Backwash Sequence.

Step	Blower	Pump	Duration
1	Blower (27.4m/hr)	1 Pump (5.7 m/hr)	5 Minutes
2	Blower (27.4m/hr)	OFF	2 Minutes
3	Blower (27.4m/hr)	1 Pump (5.7 m/hr)	1 Minute
4	OFF	2 Pumps (17.5m/hr)	3 Minutes
5	OFF	1 Pump (12.4m/hr)	5 Minutes

Table 2. Original Design Manual Backwash Sequence.

Step	Blower	Pump	Duration
1	Blower (37.4 m/hr)	OFF	2 Minutes
2	Blower (37.4 m/hr)	1 Pump (5.7m/hr)	3 Minutes
3	OFF	2 Pumps (21m/hr)	5 Minutes

Note: These air and water flowrates are at near maximum available capacity.

This backwash sequence included a number of steps that provided minimal additional value. Backwash water flow rates were not sufficient for adequate media expansion. Air scour rates were below limits recommended for adequate flocculant break up. Each filter backwash sequence was different, resulting in unequal performance. This inefficient backwash sequence began during a 1997 PLC upgrade.

In an attempt to increase backwash efficiency, the sequence was changed to closely follow the original design manual. This sequence is shown in Table 2.

Reverting back to the original design resulted in significant reductions in backwashing time, backwashing volumes, energy consumption, operating costs and headloss.

Filtered Water Flow Control

The original plant design intended filtered water flow to be controlled from the level in both the clarifier inlet and clarifier outlet. However, for many years only the clarifier outlet level was programmed to control. This resulted in a rapid control loop causing filtrate flow hunting of 80 - 100 ML/d every hour. This caused a

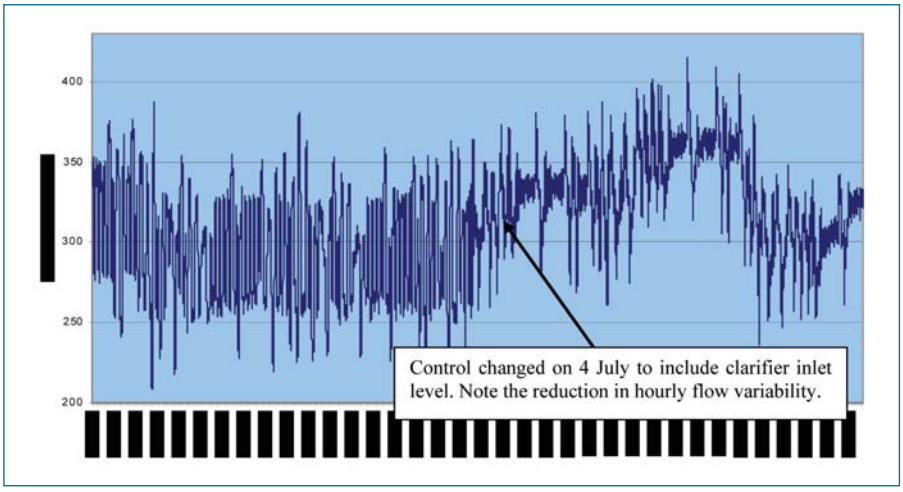

Figure 1. Filtrate flow before and after control change.

number of process difficulties, most notably chemical dosing control.

A trial began on July 4th 2005 with filter flow being controlled according to the original design. Figure 1 shows the reduced flow variability that resulted.

Further reductions in flow variability were achieved through control modifications. Reduced backwash water volumes also facilitated reduced flow variation.

Flow spikes in Figure 1 indicate backwashing. As backwash water is supplied from the filtered water channel, flow variation during backwashing is unavoidable without significant capital upgrade.

Flow and pH variance prior to and following the control change are outlined in Table 3.

Reverting to the original plant design reduced flow variance by 18%, and more importantly reduced pH variance by 49%.

Table 3. Flow & pH Variance Prior to and Following Control Change.

	Flow Variance	pH Variance
Prior to Control Change	1222	0.28
Following Control Change	999	0.14
Percentage Reduction	18	49

Table 4. Optimised Backwash Sequence.

Step	Blower	Pump	Duration
1	Blower (37.4 m/hr)	Nil	4 minutes
2	Nil	2 Pumps (21 m/hr)	5 minutes 20 seconds

Beyond the Original Design

Operating a plant based on the original design is not likely to achieve optimisation.

In the years following design and construction, the goal posts of what is perceived as best practice will shift. Operating parameters must be periodically reviewed to ensure contemporary treatment practice is adopted. Optimisation is a perpetually moving target.

Auditing consultants can identify possible process improvements.

Detailed searches on recent literature such as AWWA's *'Water Quality and Treatment, 1999'* and Kawamura's *'Integrated Design of Water Treatment Facilities, 2000'* will also assist optimisation.

Communicate with Design Engineer

Invaluable insight can be gained through communication with a plants' original design engineer. Discussions with an original Winneke design engineer concluded *'filter under-drains and launders were not originally designed to operate with a combined air and low flow water step'.*

The Winneke WTP was commissioned at a time when industry thinking adopted the combined air and water step, even though the plant was not designed for this. Winneke WTP has always operated with this combined air and water backwash step, as specified in the original design manual.

Trials were undertaken with the combined air and low flow water step removed. This two-step process of air only, followed by high rate water yielded reduced backwash time, backwash water volumes and operating costs without compromising backwash effectiveness.

Backwash Water Optimisation

After reverting to the original backwash sequence and removing the combined air and water step, the backwash sequence included air scouring followed by high rate water washing.

Backwash water turbidity at termination of backwashing should be 10 - 15 NTU (AWWA, 1999). This provides optimal filter media cleaning and minimised wash water volumes. Grab samples were taken during backwashing to determine when this occurred. Depending on process conditions, this was typically after 5 minutes 20 seconds.

The final optimised backwash sequence is detailed in Table 4. This sequence varies greatly from the previous sequence (Table 1) and the original design (Table 2).

The new backwash sequence resulted in:

(i) 38% reduction in backwash water volumes, or over 700 ML per annum.

(ii) Operating cost reduction of ~$30,000 pa due to reduced water treatment and energy costs.

(iii) Backwash pump and blower extended life due to reduced operation time.

(iv) Increased filtration capacity of 3.5 ML/d due to:

a. Backwash water volume savings (2 ML/d)

b.Backwash time savings provided increased production time (1.5 ML/d).

Optimising backwash water flows and times by measuring backwash water turbidity can provide significant operational savings.

Backwash Draw Down Level

Current industry thinking deviates from Winneke's original design. Prior to commencement of backwashing, filters had always drained to significantly *below* the top of the media, as specified in the original design. Current industry practice suggests levels should be 25-50 mm *above* the media surface to improve flocculant break up. Level probes were subsequently elevated to achieve this.

Reject to Waste

A filter ripening trial occurred where reject to waste (RTW) times were adjusted to determine the effect on filtrate water quality. During each filter ripening period, turbidity typically increased from 0.05 NTU to 0.07 NTU for approximately 10 minutes. Particle counts typically increase by approximately 600% above normal filtrate levels for approximately 5 minutes.

It was found there was no correlation between the RTW time and filter ripening data for RTW times up to 20 minutes. RTW times over 20 minutes are not operationally feasible. A filter with no RTW can have superior water quality than a filter with a long RTW.

Although inclusion of the RTW is generally recommended to remove protozoan organisms, it did not improve filtrate water quality. Its removal increased filtration capacity by 220 ML pa, reduced operating costs by $3,000 pa and improved plant reliability.

Winneke WTP from the air.

The original design RTW time was 3 minutes and the old backwash sequence RTW was 1 minute. However, optimisation was achieved with *no* RTW. Once again, contemporary treatment practice deviates from the original design.

Filter Media Levels

Media levels were found to be up to 300mm different on either side of a filter gullet. This was due to loss of media over the low gullet launders, a history of poor backwashing and air entrapment. Filter media levels on each side of the gullet must be equal to achieve optimisation. A differential height impacts filtrate turbidity, media sludge concentration and sand carryover. Media levels were equalised to address this.

Effect on Filtered Water Turbidity

Poorer filtration would be expected on the side of the filter with lower media. Measurements on the filtered water turbidity confirmed that filters with the greater media height differential had increased filtered water turbidity.

Following levelling of the media, equal filtration occurred throughout the bed. This facilitated reduced average filtrate turbidity from 0.060 NTU to 0.052 NTU (13%).

Effect on Media Sludge Concentration

Media grab samples were taken and sludge volumetric percentage measured. Media sludge concentration was found to be a function of media height. The greater the media height, the greater the media sludge concentration. Following media height equalisation, sludge concentrations became similar on each side of the gullet.

Effect on Sand Carry Over

Filters with a greater height differential between each side of the gullet were found to have greater overall media loss. The filter with the greatest media height difference (300mm) lost the greatest volume of sand (over 30%). This is due to a lower pressure differential across the low bed, causing greater backwash flows. This creates additional turbulence in the low bed, which promotes sand carryover. Media height difference and media loss is a snowballing problem.

Air Entrapment and Sand Carryover

During backwashing, a significant amount of air rose through the media bed for up to 8 minutes *after* the air blower turned off. This occurred during the high rate wash and caused sand carry over into the gullet. Since 1980 this has resulted in a loss of around 0.28m of the original 1.00m of sand.

The author standing in the "gullet".

Investigations into the source of the air revealed leaks in the backwash pump non-return valves. This allowed water to pass from the backwash water duct into the backwash water tank. Large volumes of air then entered the backwash water duct through an air valve. After replacing all backwash water pump non-return valves, the majority of air escaping through the bed ceased.

Pea Gravel Layer

The pea gravel layer has been severely disrupted with gravel scattered throughout the sand. In some sections the layer no longer exists whilst in other areas the layer is over 500mm. The disruption is due to the method of operation of backwash water control valve, a history of inappropriate backwashing and air entrapment.

During backwashing it is essential that the backwash valve is opened slowly to prevent disturbance of the gravel (AWWA, 1999). To reduce further disturbance of the remaining pea gravel, the backwash control valve opening time was increased from 9 seconds to over 60 seconds. Similarly the closing time was increased from 9 seconds to 30 seconds.

Pea gravel can also be disturbed during combined air scour and water backwash (AWWA, 1999). This occurred for extensive periods during the old backwash sequence. The optimised backwash sequence has no combined step. It also has a long high rate wash step to aid bed reconstruction.

Headloss

Optimised filtration reduced terminal headloss by 15%, which resulted in filter run times of over one hour longer.

Outcomes

The Winneke Water Treatment Plant filter optimisation program resulted in reduced annual operating costs of over $30,000, reduced filtrate turbidity of 13%, increased filtration capacity of over 4 ML/d, reduced media losses, reduced headloss of 15%, reduced flow variance of 18%, reduced pH variance of 49% and reduced annual backwash water requirements of over 700 ML.

Acknowledgments

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PROBLEMS WITH LINERS AND COVERS

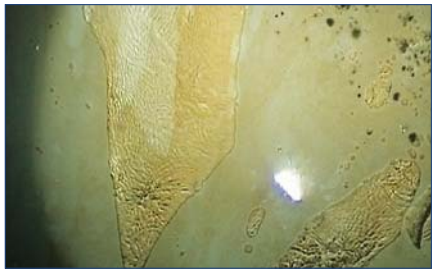
Peter Norder

The use of basins with liners and floating covers is regarded as an innovative and practical solution for storing potable water. In theory the precious treated water is completely enclosed and thereby protected from the introduction of foreign objects and general contamination, e.g. bird droppings and growth of algae.

However, in practise there are many faults and failures that need to be considered when designing, constructing and maintaining this type of storage.

Cleaning and inspection of floating cover storages is generally achieved by diving operations and/or remotely operated vehicles. Emptying of the basin and inflating the cover with air is an option but can expose hazards as a confined space and collapse of the roof. Dumping of the water can also be wasteful.

The following observations have been noted during our regular inspections and cleaning of lined and "floating" covered storages. The purpose of the article is not to criticise or recommend the use of "bladder" type storages. However the common observations described here may assist in making choices of future design, installation and maintenance of this type of storage.



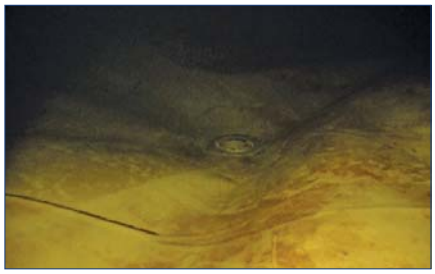
A hole in a floating cover.

A split in a floating cover.

A substantial hole in a basin liner.

A hole in a liner.

Basin liner meets the floating cover.



Pooling of water below the liner.

Security

The "water bed" effect of the floating cover can attract inquisitive children to the pleasures of frolicking for hours on their own private giant "jumping castle". I must admit I have enjoyed the odd "moonwalk" myself.

This is obviously an important public safety consideration, as plastic welds can fail and vandalism such as throwing rocks and steel stakes through the cover can compromise the integrity and strength of the cover. We have noted several acts of unauthorised entry and vandalism that have resulted in large holes in the cover and foreign objects littering the internal floor. It is interesting to note that even large splits in the covers that are often not obvious from above become clearly visible from in the water due to the sunlight streaming through the split or hole.

Site Preparation

Good ground preparation is important. When cleaning the basin floor, any lumps and bumps make vacuuming difficult and some sediment can be left in troughs and depressions. We have found some of the underlying walls have avalanched and heavy vehicle depressions become evident through the liner. Good substrate preparation makes for a sound base to work from. The walls should have a shallow slope to assist with vacuuming. Steep rough walls are very hard to vacuum.

Water Entrapment

We have found many storages with entrapped water underlying the liners, sometimes reducing the available potable stored water to less than 20% of its available capacity. In most cases this problem has not been discovered until an inspection has been conducted.

Ground water as well as internal leaks can cause water to be trapped between the floor liner and the underlying base. Geo-fabric might be considered to ensure an even floor, which provides some drainage capability.

A means of extracting large volumes of water from beneath the liner is also important. This can be achieved via a simple pipe installed under the floor with a capped outlet at the basin edge, to enable water to be pumped away.

Choice of Liner and Cover

Many different materials, styles and colours of liners exist. Some basins have a light coloured roof, that allows light to penetrate and others are dark which allow little to no light.

Some concerns have been aired that sunlight penetration will allow algal blooms to grow. Whether this is true or not, I don't know. I can say that we have not as yet found any algal blooms in any floating covered basins whether it is light or dark.

As a personal choice we prefer the lighter coloured floor liners. They help with visibility, orientation and grip during cleaning operations.

Of interest we have been asked to inspect creases in basin liners. Apparently, given the

right conditions, some liners can deteriorate at a crease and spilt. This is often evident by the crease appearing grey in colour at the site of a possible split. We have already found one basin with this condition and are always on the lookout during our inspections.

In general, it is important that creases are eliminated as much as possible during installation to reduce fabric fatigue, roof water pooling and floor sediment accumulating in craters. Also a good strong seal is fundamental around inlets, outlets and scours. A poor seal will allow water to leak between the floor liner and substrate base.

Entry of Contaminants

A well-sealed cover should prevent most common contaminants from entering the water column. Often, cover penetrations are forgotten. This can compromise bird proofing and provide entry points for contaminants. Evidence of possums, birds, leaf debris and foreign materials are often found inside the lined and covered basins.

Examples of penetrations through floating covers that may be a problem include:

- Telemetry pipes
- Vents
- Overflows
- Sampling pipes.
- Dosing points

Cover Care

Weeds and dirt can accumulate on the top of floating covers. There is plenty of evidence that weed roots can penetrate the cover and enter the water column.

Recommendations for Cover and Liner Design Based on our Experience

The following suggestions are based on our experience working on and in basins.

- Access to the basin needs to restricted by use of appropriate security fences
- Access gates should be locked at all times
- Ensure the surface where the liner will be placed is sound and smooth and free of objects that may deform and possibly penetrate the liner
- Consider the use of thick layers of geofabric to protect the liner
- Ensure that that there is a system to allow drainage from under the liner
- Anti slip devices should be installed on all walkways.
- Padded walkways should be installed to each point of interest on the cover
- Anchor points should be included with each walkway to allow securing of a safety line
- Protruding nuts and bolts at the walkway edge should be covered and padded to avoid injury

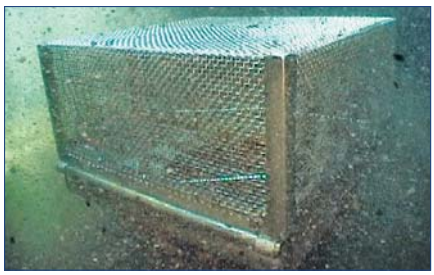
A defect in an internal liner.

Possum remains in a fully 'sealed' basin.

Surface weeds growing on a floating cover.

Roots penetrating a floating cover.

Roots penetrating a floating cover.



Protective mesh cage in place around a basin outlet.

- Access to the cover should be confined to the walkways
- A rescue ring and lanyard should be installed in a covered housing at each walkway. (Exposed lanyards will deteriorate and become unsafe)
- Install lockable secure hatches with a raised edge of a size at least 1 meter x 1 meter
- Ensure enough floatation under each hatch to support at least 3 people and equipment
- Install removable safety cage under each hatch

Regular cleaning of the top of the cover should also not be forgotten.

- Remove weeds and grasses
- Assist roof pump in removal of accumulated water
- Regularly clean the floating roof cover
- Ensure a good external seal
- Repair any holes

Depth of Storage

Since divers are commonly used for inspection and cleaning, consideration should be given to the size and depth of the storage. Some basins are the size of "football grounds" and can take weeks of repetitive dives to clean. Divers are restricted in time spent underwater, at a given depth, because of the risk of decompression sickness.

A depth of up to 6 meters is ideal for decompression times and may reduce thermal layers within the water column.

Outlet Protection

In many basins there are often protective bars placed over the outlet to stop the liner from entering the outlet. The bars are generally wide enough for the diver to swim through. In large basins with high outlet flows this presents a potentially fatal hazard to divers.

We recommend a 3 dimensional, fine mesh cage be installed on all outlets to protect the diver and prevent foreign objects from entering the system while at the same time not restricting water flow.

In general, lined, floating covered basins are like my dear wife. "High maintenance". However with some regular care and attention a long and lasting quality relationship can be achieved. (With the basins too!)

The Author

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ADVANCED OXIDATION PROCESSES AND INDUSTRIAL WASTEWATER TREATMENT

A J Feitz

Abstract

Advanced oxidation processes (AOPs) such as UV/O_3 or UV/H_2O_2 are becoming increasingly mainstream treatment technologies for trace contaminant removal from groundwaters and drinking waters. Adoption of AOPs for industrial wastewater or process water treatment has been less successful, in part due to cost, but also due to the difficulty in selecting the most appropriate AOP for particular industrial wastewater applications. This paper summarises the advantages and limitations of AOPs for industrial wastewater treatment, suggests suitable wastewater types for AOP treatment, and reports on some recent advances in our understanding of AOPs that have relevance for industrial wastewater treatment.

Introduction

Advanced oxidation processes (AOPs) have been the subject of intense research over the last 30 years and many extensive reviews have traced their technological development (Legrini *et al.*, 1993; Parsons, 2004). While there are thousands of scientific papers documenting the effectiveness of AOPs for contaminant destruction, AOPs have often struggled to achieve mainstream acceptance as a viable water and wastewater treatment alternative. Viewed historically as too costly or unreliable, recent improvements in technology and energy efficiency, and more importantly matching technologies with suitable applications, has resulted in greater adoption of AOPs in the water industry. UV light in combination with hydrogen peroxide or ozone is now widely used in drinking water and groundwater treatment for trace contaminant removal.

Table 1. AOPs for water and wastewater treatment.

Full scale	Pilot scale	Bench scale
UV/H_2O_2	Photocatalysis	Pulsed plasma
$UV/H_2O_2/O_3$	Ultrasound	Microwave
O_3/OH^-	Photo Fenton	Electrochemical
O_3/H_2O_2		Ferrate
Supercritical water oxidation		Fenton-like reactions
Wet air oxidation		
Fenton's reagent		
Ionising radiation (electron beam)		

The focus of this short review will be application of AOPs for industrial wastewater treatment with a preference for process water recovery. In most cases, biologically treatment is the most logical and cost-effective treatment option for industrial wastewater treatment. There is potential for energy recovery (i.e. anaerobic fermentation and methane generation) and

Expensive, but can work where bugs fail.

nutrient recovery; biological treatment has a low energy requirement and treatment is invariably less expensive. There are some circumstances, however, where biological treatment is not an option and this is where AOPs may provide a useful treatment alternative. Perhaps the wastewater is highly toxic, biologically inert, or there are process limitations that exclude biological treatment (e.g. requirements to maintain high pH or fast treatment at high temperature). The enormous variety of AOPs (Table 1) and their different configurations present an opportunity to tackle even the most difficult wastewater. Technologies range from UV light systems coupled with ozone, hydrogen peroxide or solids catalysts (photocatalysis) through to ultrasound and electron beams. However, selection of the most appropriate AOP from the myriad of available technologies can be challenging. Different AOPs perform better under different conditions (e.g. pH, temperature) and without a detailed understanding of the chemistry involved and physical limitations it can often be difficult to select which AOP to use for a given wastewater.

Advanced Oxidation

The common element for all but two of the technologies listed in Table 1 is that they generate highly reactive oxidants at ambient temperatures, including the hydroxyl radical ($^{\bullet}OH$). Both supercritical water oxidation and wet air oxidation also generate hydroxyl radicals but under high pressures and temperatures. The hydroxyl radical is one of the most powerful oxidising species known. It has a very high oxidation potential and reacts with contaminants much faster than other oxidants (Table 2). Hydroxyl radicals are highly unstable because they contain an unpaired electron in their molecular

structure and will extract an electron or hydrogen atom from the nearest compound to convert into the more stable hydroxyl ion or water. They are therefore highly reactive and rapidly oxidise virtually all classes of organic and inorganic compounds (Buxton *et al.*, 1988). Other commonly encountered oxidants such as hypochlorite, hydrogen peroxide or ozone are less reactive because they contain paired electrons in their molecular structures (Figure 1).

Hydroxyl radicals react with organic compounds by three pathways: hydrogen abstraction (e.g. Eq 1), addition (e.g. Eq 2) or electron transfer (e.g. Eq 3):

$$CH_3OH + OH^{\bullet} \rightarrow {}^{\bullet}CH_2OH + H_2O \quad (1)$$

$$C_6H_6 + OH^{\bullet} \rightarrow {}^{\bullet}C_6H_6OH \quad (2)$$

$$C_2O_4^{2-} + OH^{\bullet} \rightarrow C_2O_4^{\bullet-} + OH^- \quad (3)$$

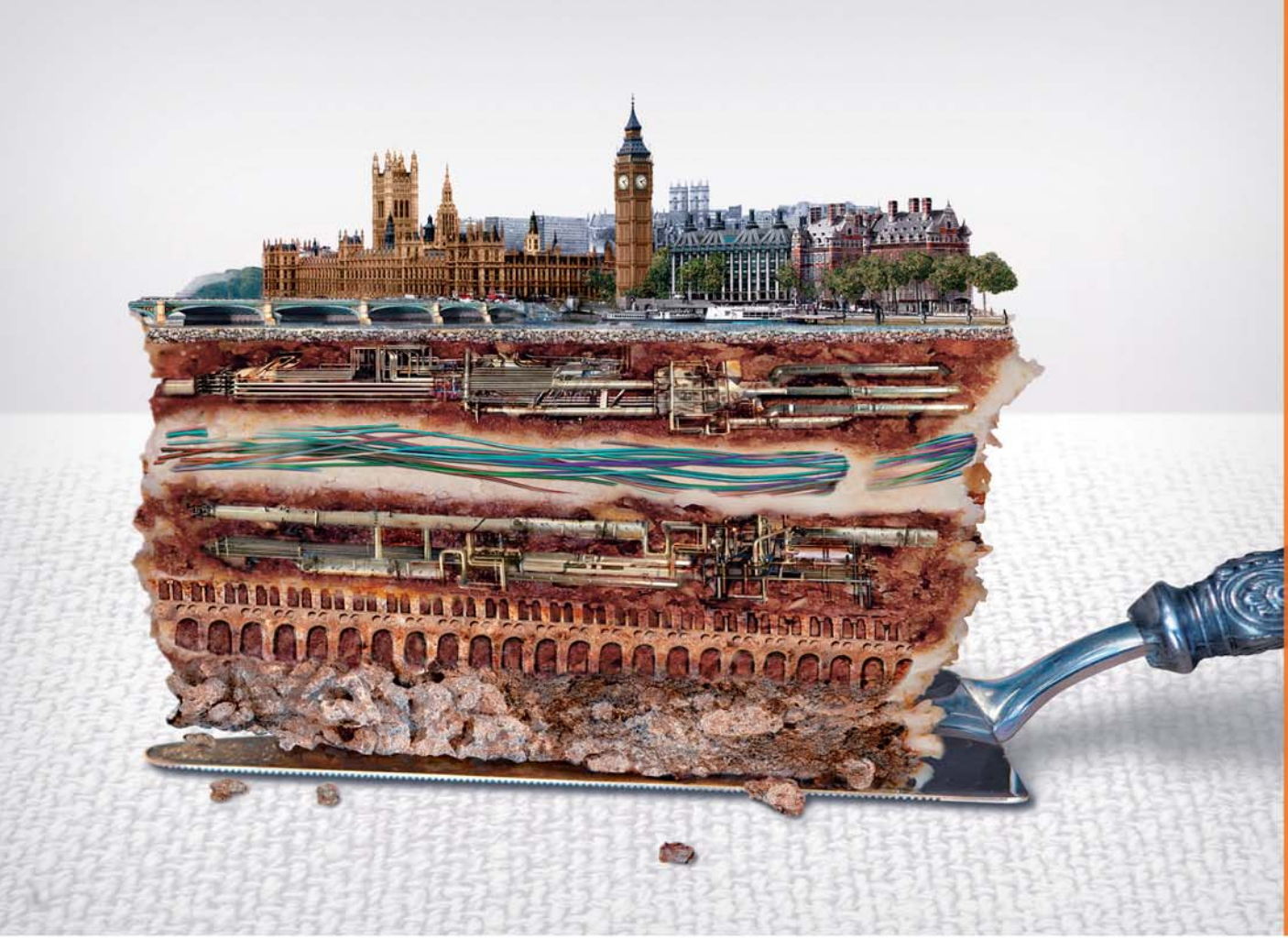
Typically hydroxyl radicals react with saturated organic compounds by hydrogen abstraction, while addition reactions occur between $OH^{\bullet}$ and aromatic or unsaturated compounds. Some organic compounds such as $C_2O_4^{2-}$ react with hydroxyl radicals by electron transfer. The reaction between $OH^{\bullet}$ and inorganic ions is often represented as a simple electron transfer, but it is more likely that an intermediate adduct is formed, e.g.

Table 2. Oxidation potential of common species and second order rate constants for selected oxidants with phenol.

Species	Oxidation potential (V)	Rate constant k_{phenol} ($M^{-1}s^{-1}$)
Fluorine	3.03	
Hydroxyl radical	2.80	1.4×10^{10}
Sulfate radical	2.70	
Ozone	2.07	1.3×10^{3}
Hydrogen peroxide	1.78	
Permanganate	1.68	
Hypobromous acid	1.59	
Chlorine dioxide	1.57	0.24
Hypochlorous acid	1.49	
Chlorine	1.36	

$$Cl^- + OH^{\bullet} \leftrightarrow ClOH^{\bullet-} \leftrightarrow Cl^{\bullet} + OH^- \quad (4)$$

Hydroxyl radicals will oxidise carbon-containing compounds to carbon dioxide, nitrogen to nitrate, sulfur to sulfate and phosphorous to phosphate given sufficient exposure. Halide containing compounds are oxidised to their dissociated mineral acids (e.g. Cl^- and Br^-) and metals are oxidised to their higher oxidation states (e.g. Fe(II) to Fe(III)), which can sometimes have unintended consequences such as oxidising Cr(III) to the more toxic Cr(VI) oxidation state. While AOPs can completely mineralise most organic contaminants, converting them to CO_2, H_2O and inorganic ions, this is not always necessary or cost-effective. Partial degradation will usually reduce the toxicity and increase the degradability of the contaminants (Bolton and Cater, 1994), but in some cases may generate intermediates that are toxic to humans or inhibitory to biological treatment processes (Pelizzetti, 1999). Additional exposure is required in such cases.



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While hydroxyl radicals are extremely powerful oxidants, their non-selectivity can prove problematic when degrading wastewaters with high concentrations of background inorganics. For high alkalinity wastewaters, a large proportion of the hydroxyl radicals will directly react with carbonate and bicarbonate species or chloride or sulfate ions if present at high concentrations. Reaction with hydroxyl radicals and carbonates will form carbonate radicals, which have lower (although when compared to O_3 still high) oxidation power. The formation of chloride radicals is mostly short-lived as they react with water to reform hydroxyl radicals except at very low pH and high concentrations of chloride. Even in the presence of high concentrations of chloride, such as with alkaline and salty textile wastewaters, there is not a significant decrease in oxidation efficiency with as the chloride radicals themselves are rapid oxidants (Aplin, 2001).

Suitable Wastewaters and Suitable AOPs

Industrial wastewaters are often characterised by unique wastewater compositions and the level of treatment required depends on the end use. Biological treatment is more energy efficient (and less expensive) for removing high concentrations of organics but there are some situations where AOPs may offer an advantage as indicated below:

- Process limitations/fast treatment
  - e.g. above ambient temperatures and need to prevent odour release in cooling dams
- High COD/TOC but biologically dead (no BOD)
  - Very toxic (e.g. highly chlorinated or landfill leachate)
  - Inert (e.g. plastics wastewater)
- pH limitations
  - high pH (e.g. wastewater contains high S^{2-} or CN^- and need to maintain at high pH to limit toxic gas release)
  - low pH wastewaters are generally suitable for all AOPs
- Toxic sludge
  - Disposal of highly toxic sludges is achievable using wet air oxidation

Process or cooling waters for example may require removal of particular odorous compounds but achieving a high degree of total soluble organic removal may not be necessary. In such cases, fast treatment of highly odourous organics prior to discharge to cooling ponds could reduce the potential for odour complaints.

AOPs typically have a small footprint and can be readily integrated with other treatment processes. For example, they may be used to degrade non-biodegradable compounds that remain after biological treatment of contaminated wastewater. Alternatively, some industrial wastewaters are strongly resistant to biological treatment and have a very high organic content as measured by TOC/COD but little BOD. AOPs can be used to partially degrade toxic, inhibitory or refractory compounds in such wastewaters to more biodegradable compounds prior to biological treatment. Landfill leachates are a good example of biologically dead wastewaters with COD values typically around 1000 ppm but with BOD values less than 20 ppm.

The very specific requirements for some industrial wastewaters can automatically rule out certain full-scale advanced oxidation processes. Where a wastewater contains high concentrations of sulfide or cyanide, an alkaline pH is maintained to prevent protonation and potential release of toxic H_2S or HCN gases. For such wastewaters, Fenton processes are not appropriate as they need to operate at pHs between pH 2-4. Despite the fact that the Fenton process has the capacity to produce hydroxyl radicals capable of oxidising both H_2S and HCN to non-toxic ions, the rate of reaction may not be sufficiently fast to out compete volatilisation of the toxic gases. AOPs more suitable for high pH wastewaters include O_3/OH- as indicated in Table 3.

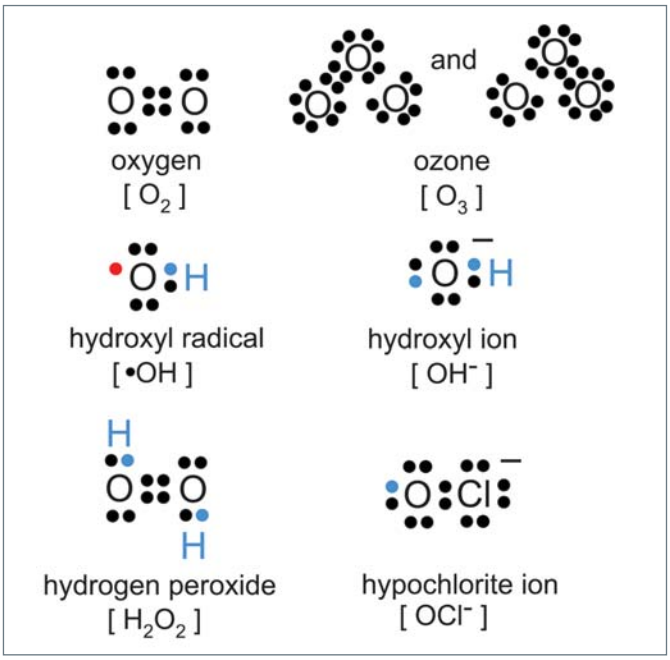

Figure 1. Lewis dot structures for different oxidants, showing the unpaired electron for the hydroxyl radical.

Recent Developments

Fenton-like reactions: Fe(II)/HOCl and ZVI/O_2

Recent research has uncovered several Fenton-like reactions that may have groundwater and wastewater treatment applications. Fenton's reagent ($Fe(II)/H_2O_2$) produces a highly reactive oxidant, which has traditionally been thought to be the hydroxyl radical:

$$Fe^{2+} + H_2O_2 \rightarrow FeOH^{2+} + OH^{\bullet} \quad (5)$$

It has however, been established that H_2O_2 must react with Fe(II) by forming an intermediate complex (Goldstein *et al.*, 1993; Bossman *et al.*, 2004):

$$L\text{-}Fe^{2+} + H_2O_2 \leftrightarrow L\text{-}Fe(H_2O_2)^{2+} \quad (6)$$

The non-participating ligand L may be a coordinated water molecule or another ligand, and can be uncharged (as written here) or charged. The transient complex can react directly with organic compounds, or can decompose to produce a hydroxyl radical or a Fe(IV) "ferryl" species (Goldstein *et al.*, 1993; Walling, 1998):

$$L\text{-}Fe(H_2O_2)^{2+} \rightarrow L\text{-}Fe^{2+} + OH^{\bullet} + OH^{-} \quad (7)$$

$$L\text{-}Fe(H_2O_2)^{2+} \rightarrow L\text{-}Fe^{4+} + 2OH^{-} \quad (8)$$

There are therefore three possible oxidants - the intermediate complex, the ferryl species or the hydroxyl radical. The relative importance of these oxidants will depend on the nature of L, the solution composition (reactant concentrations, pH) and the relative reactivities of the oxidants with other compounds that are present (Goldstein *et al.*, 1993; Bossman *et al.*, 2004).

A similar reaction has been uncovered during cancer research at the Gray Laboratory (UK) in 1993 where instead of hydrogen peroxide being the primary oxidant, reaction between and Fe(II) and hypochlorous acid (formed in the human body via the enzyme myeloperoxidase) is another source of hydroxyl radicals or ferryl species:

$$Fe^{2+} + HOCl \leftrightarrow Fe(HOCl)^{2+} \rightarrow FeCl^{2+} + OH^{\bullet} \quad (9)$$

$$Fe^{2+} + HOCl \leftrightarrow Fe(HOCl)^{2+} \rightarrow Fe^{4+} + OH^{-} + Cl^{-} \quad (10)$$

The reaction is approximately 1000 times faster than the standard Fenton reaction (Candeias *et al.*, 1994) and, while later discovered not to be primary source of hydroxyl radicals in the human body (Folkes *et al*, 1995), it has direct relevance to wastewater treatment as a potentially cheaper Fenton treatment alternative.

Another interesting Fenton-like reaction is the reaction between elemental iron (zero valent iron) and oxygen. In the classical iron corrosion process, as metallic iron is oxidised to soluble ferrous (Fe^{2+}) it releases electrons which react with oxygen and water and form hydroxyl ions (OH^-), i.e.

$$2Fe^0 + O_2 + 2H_2O \rightarrow Fe^{2+} + 4OH^{-} \quad (11)$$

Recent research with iron nanoparticles (Joo *et al.*, 2004) has revealed that a Fenton-like process may also occur where metallic iron reacts with oxygen to produce hydrogen peroxide and Fe(II) - the primary reagents for the Fenton reaction (eq 5).

$$Fe^0 + O_2 + 2H_2O \rightarrow Fe^{2+} + H_2O_2 + 2OH^{-} \quad (12)$$

The studies confirmed the oxidative degradation of organics (e.g. the herbicide molinate) and the appearance of oxidation byproducts when used in the presence of iron nanoparticles and oxygen. The production of oxidants was not limited to nanoparticles. Granular iron, the type used in reductive iron barriers for reductive degradation of chlorinated organics (Hannesin *et al.*, 1998), was also able to produce oxidants, albeit at a lower rate (Joo *et al.*, 2005). The results raise interesting questions about the role of oxygen in iron barriers and whether

Table 3. Suitability of advanced oxidation processes for industrial wastewater treatment.

Advanced oxidation process	Limitations	Advantages
Ozone/high pH	• High capital and operating costs • Ozone highly toxic gas - need good controls	• The most effective AOP for high pH wastewaters • Ozone decomposes to O_2 and H_2O - does not introduce trace metals into wastewater • Recent research indicates ozonation may be effective at high temperatures
Electron beam (non thermal plasma)	• Not widely used for wastewater treatment (treatment rates not well known) • High capital costs but small operating costs	• Does not require physical contact with wastewater • No chemical additives
UV/H_2O_2	• Risk of scaling on quartz sleeves, especially for high alkalinity wastewaters • Lamp performance deteriorates at high temperatures • Colour and turbidity reduces efficiency	• The most widely used AOP - established technology • No metal additives • Fast treatment
Fenton-based processes	• Operation limited to pH 2-4 for dark Fenton; pH 3-6 for modified photo Fenton • Introduction of Fe might affect downstream processes • Production of $Fe(OH)_3$ sludge	• Only AOP that does not require additional energy • Low capital costs and relatively inexpensive reagents • Suited for batch treatment • Effective at high temperatures
TiO_2 photocatalysis	• Optimum pH conditions are typically acidic • Slow throughput rate for aqueous systems (more effective for gaseous treatment) • Likelihood of scaling on quartz sleeves, especially for high alkalinity wastewaters • Catalyst separation/immobilization can be difficult - potential for catalyst carry-over into treated wastewater • For high concentrations of organics, need to add additional electron scavenger such as H_2O_2 • Lamp performance deteriorates at high temperatures • Colour and turbidity reduces efficiency	• TiO_2, the most widely used photocatalyst, is non-toxic and relatively inexpensive • Low operating costs • Catalyst can be regenerated and reused repeatedly • For systems that do not require fast throughput, solar energy can be used.
Wet air oxidation	• High energy requirements due to high pressures and temperatures (exceeding 100 MPa and 300°C) • Long reaction times • Catalytic WAO introduces metal contaminants such as copper that may affect downstream processing	• Most widely used AOP for destruction of toxic sludges
Supercritical water oxidation	• High energy requirements due to high pressures and temperatures (typically 25-35 MPa and 450-650°C) • Long reaction times	• No chemical additives
Ultrasound	• Immature technology	• Great potential, especially if coupled with ozone

there are opportunities to use them for the oxidative remediation of groundwaters contaminated with soluble trace organics.

High temperature/high pH ozonation

An important consideration for ozone systems is that ozone solubility decreases markedly with increasing temperature and ionic strength (Kosac-Channing and Helz, 1983). It is often recommended not to use ozone above temperatures of 40°C due to ozone solubility limitations. However, several studies have shown little dependence of degradation performance on temperature, especially at neutral to high pH (Hostachy *et al.*, 1997; Oeller *et al.*, 1997). One notable recent study by Bijan and Mohseni (2004) looked at the application of ozone for pulp and paper wastewater (COD = 1600mg/L) at pH 9, pH 11 and temperatures 20°C and 60°C and found no significant difference in degradation performance. The result is surprising considering that ozone solubility decreased from 0.31 mg/L of ozone in water per mg/L of ozone in air at 20°C to 0.093 at 60°C. Ozone decomposes rapidly in the presence of hydroxide ions (i.e. at high pH) to form hydroxyl and superoxide radicals (Staehelin *et al.*, 1984; Bühler *et al.*, 1984) and together with the enhancement in oxidation kinetics due to the increased temperature, this is considered to counter the effect of lower concentration of ozone in solution due to lower solubility.

The early results of Bijan and Mohseni (2004) offer a tantalising prospect for industrial wastewater treatment where organic contaminant removal could be conducted at high pH, atmospheric pressure and elevated temperatures. UV light AOPs such as UV/O_3, UV/H_2O_2 or UV/photocatalysis are often configured so that the lights are housed in quartz sleeves and immersed directly into the wastewater. This is a favourable configuration at low water temperatures but at 40°C and above lamp performance deteriorates with increasing temperature (IESNA, 1993). The deterioration is to some degree offset by an increase in reaction kinetics with increasing temperature. Inorganic scaling on the quartz sleeves will also be exacerbated for high alkalinity wastewaters at elevated temperatures. High pH ozonation therefore offers a potentially ideal approach for organic removal for high alkalinity wastewaters at elevated temperatures.

Conclusions

Advanced oxidation processes may not be appropriate for industrial wastewaters in the majority of cases, but there are certain situations where they are a useful treatment option. These include increasing the biodegradability of toxic or inert wastewaters and fast treatment where process limitations or wastewater characteristics exclude more conventional wastewater treatment approaches (e.g. high pH or temperature). Improvements in our understanding of AOPs (e.g. Fenton-like and ozone/OH^- processes) is leading to the discovery of new reactions, new potential technologies, and finding operating conditions more suited for industrial process water and wastewater treatment applications.

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In collaboration with partner associations

AUSTRALIAN WATER ASSOCIATION

WASTE MANAGEMENT ASSOCIATION OF AUSTRALIA

Partner

Victoria The Place To Be

ENVIRO 06 - WATER EVENTS OUTLINED

In the **Enviro 06** program, water Events, in approximate, source to tap order are:

Catchment Management (convened by Dr Dan Deere) will have **Bob Ford**, of Central Highlands Water, as keynote speaker on planning water catchments for the future, and **Sheila Barry**, University of California, on the application of HACCP to San Francisco's water supply.

NOM (Dr Gayle Newcombe) gets off to a flying start with **Prof Don Bursill**, of the CRC for Water Quality and Treatment, telling the story of NOM; past, present and future. It also features **Jean-Philippe Croue**, who looks at dissolved organic nitrogen during water treatment.

Disinfection (Ron Howick) will have **Prof Steve Hrudey** as keynote. Steve is well known in Australia and has been actively involved with the introduction of risk-based guidelines and the appraisal of epidemiology.

Integrated & decentralised systems (Sarah West) has **Prof Kevin White**, from the University of Southern Alabama, describing functional models and infrastructure costs for centralised and decentralised models. The day then addresses integration in centralised systems; decentralised systems; and modelling and assessment methods.

Urban groundwater (Dr Peter Dillon). **Prof Ken Howard** from University of Toronto will be the keynote speaker and he will talk about groundwater as an instrument for sustainable urban growth, health and prosperity. Other themes through the day include dynamic groundwater effects; decontamination; and managed aquifer recharge.

Asset management (Chris Adam) features **Dr Wayne Stewart**, of Opus, as its keynote, and his topic will be leadership in asset management - why we need more leadership and less management. The rest of the day includes wide ranging papers from utilities, consultants and academics.

Wastewater treatment (Robbert van Oorschot) has **Nick Walmsley**, from GHD in New Zealand, giving a view of biosolids options that face today's managers. The large collection of papers for the rest of the session covers every facet of wastewater treatment today.

Monitoring & analysis (John Parker) is to have keynote speaker, **Dr Rob Vertessy**, Chief of CSIRO's Land & Water Division, outlining moves to establish an Australian Water Resources Observation Network. The Event will also cover biomonitoring and monitoring and analysis of processes.

Reuse (John Anderson) will have **Mike Wehner**, from Orange County in California as keynote. Mike is a leading figure in this area and Orange County is a leader in ASR. This Event will be jointly run with AWWA and WEF, and their current Presidents, **Andy Richardson** and **Michael Read**, are both reuse aficionados; so they will be on the program too.

To appeal to those who look at the big picture, **Mark Pascoe** has assembled a two-day Event on **Urban Sustainability**, with water as a key component.

More than half the maximum number of booths has been sold (to 119 exhibitors), so the Exhibition will be worth a day on its own.

Delegates can register for each day separately, taking one, two or three days; and delegates can move between Events on a given day. This makes Enviro 06 very attractive and cost effective for time-poor practitioners.

Registration opens January 2006

Supersaver discount closes 28 February 2006

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AN ALLIANCE CONTRACT FOR A HIGH-TECH PIPELINE

G Hogarth

Abstract

This paper summarises the success of a three-party alliance which delivered a 400km gas pipeline on time and under budget and with benefits to all its stakeholders.

Although not a water pipeline, the system of project delivery is very relevant to readers of *Water.*

(This version, prepared by the Editor, is based on an interview with the Project General Manager, Graeme Hogarth, published in *GHD News,* Issue 123).

Introduction

In early 2002, Enertrade won the right to develop a project to provide gas-fired power generation in Townsville, Queensland. A critical part of the project was to extract gas from coal seams in the Northern Bowen Basin near Moranbah and deliver the gas almost 400 kilometres to Townsville.

A gas compression and treatment plant at Moranbah was needed to pressurise and dehydrate the gas, along with the construction of 369km of 323mm dia high pressure gas pipeline from Moranbah to Townsville Power Station and 23km of 273mm dia pipeline branch to the Stuart industrial precinct. The pipelines were completed in September 2004 some 11 months after start of construction and under budget. The alliance employed up to 350 personnel at the peak construction period. (See the Box for some details).

From a project management perspective, the North Queensland Gas Pipeline Project (NQGP) project set a new benchmark for the pipeline industry by taking a fresh approach to project delivery. The Owner, Enertrade, selected GHD for the engineering design and Thiess Nacap for construction, both on the basis of their partnership approach. Rather than having one contract for design and another for construction, an alliance of these companies together with the owner was developed because it provided a basis for people to work together and focus on the output they collectively wanted to achieve in the most efficient manner. The alliance gave the team the opportunity to focus on delivering a value-added solution and respond collaboratively to issues that arose. It focused on 'best for project' outcomes and worked to ensure that its values such as innovation, quality, safety and consideration for both the community and the environment, were upheld at all times.

This alliance included three different organisations, each with its own culture, which came together as one team.

The alliance delivery method enabled an integrated project management team approach which included:

- A no-blame, no litigation framework, rather than a traditional adversarial contract.
- Operational and construction input into the design and engineering process from the start.
- Exposure to construction and operational practices for design engineers with an emphasis on solving problems rather than simply producing designs.

It was a particularly suitable strategy for this linear project because of the stakeholder interfaces, potential weather events, latent conditions and logistical management requirements. The alliance participants also shared in the risk and reward.

The Key Element

The NQGP alliance included three different organisations, each with its own culture, which came together as one team. The key was being able to work collaboratively. Projects of this nature require exceptional planning and interaction as well as preparation for the unexpected.

The impact of delays during construction will usually cause costs to balloon. In a lump-sum arrangement, the constructor often has little input into the planning and design stages. This can escalate project risks and create an adversarial atmosphere, particularly as the construction period tends to be constrained by delays.

There is no such a thing as clear risk transfer on construction projects. The governing rule for the alliance, agreed at project inception, was that those in the team best able to address a risk were allocated the management of that risk and its related tasks. This attitude held over the full duration of the project throughout the alliance team and the sub-contractors.

Did Bid Price Present a Challenge?

Price was not an issue as all alliance participants set a challenging target price to ensure the original project budget would be met. The alliance price was based on a rigorously risk-and-opportunity-assessed cost estimate involving all parties and a genuine open book approach. Price itself is not the driver in the selection of an alliance team but management of cost measured as value is a key driver.

The Greatest Achievements of this Project

Other than the fact that the project was delivered on budget and on time, two achievements stand out. The first achievement was the absence of rework which, on a project of this complexity, was amazing.

The second achievement was the ability to effectively overcome problems as they arose. This was achieved by operating as a united team that focused on outcome by practising sound project and risk management skills whilst always putting safety and environment as the priority.

The Manager Technical Services, Chris Gorham, recalls one major issue that arose in the design phase. "A group of five or six alliance personnel gathered in my office to discuss a design issue and with a white board and marker, brainstormed a solution within twenty minutes. The result was that a major issue that was identified was resolved immediately allowing the design engineers to continue virtually uninterrupted, all this without a single email or letter being written between the participants. A similar situation under a 'normal contract' could have taken two weeks to resolve, with laborious processes and numerous letters and emails back and forth. This is just one example of the NQGP Alliance's good project management skills - a clear brief, commitment to working together, and 'best for project' attitude. A lot of entities pay lip-service to these concepts, but in the case of the NQGP project, this was truly an authentic alliance."

The review of the compressor station pipe layout used 3-D piping software. Use of this software is not unique, however the ability to use the model with engineering, construction and operations simultaneously saved time and money by resolving most issues in the one review session.

Another good example of collaboration occurred during directional drilling under a riverbed. There were major problems with the drills and they had to be abandoned; but within one hour an open-cut was started. Whilst the impact of this event was significant, the availability of the combined skills of the whole team together with the risk mitigation work previously undertaken for this perceived high risk meant that the impact was minimised both in cost and time. In a lump-sum contract this problem would have had a huge impact on the project schedule, possibly delaying the delivery by six weeks, not to mention the increased cost.

Early in the project the four 150-tonne compressor units arrived three weeks late. In a lump-sum contract situation, the contractor would have charged heavily for this. The alliance team responded by reassigning and re-skilling the workforce to continue alternative tasks that could be carried out immediately and so got on with the project.

Notable Environmental Outcomes

One of the most satisfying initiatives was the fauna recovery system. When you cut a 1.5 metre deep trench over 400 kilometres, you are bound to disrupt the lives of many creatures. With the help of two museum specialists, the project rescued over 3,000 animals, including echidnas, lizards, green tree frogs and snakes with over 90 examples of one species of snake which previously had been categorised as vulnerable. Each animal was identified, logged with a Global Positioning System (GPS) and relocated to adjacent habitat.

Relationship with the Landowners in the Region

The project negotiated with 65 individual landowners for easement access and also completed the longest contiguous Indigenous Land Use Agreement (ILUA) in Australia. This involved reaching three ILUA agreements with nine traditional owner groups along the length of the pipeline. This was achieved with full registration with the Native Title Tribunal around Christmas 2003, 18 months after commencing negotiations.

Summary

The cooperative spirit of the alliance allowed single point consistent communication and excellent stakeholder relationships. Similarly management was able to focus on outcomes to the benefit of the people involved and the whole of project value. The constant feedback from those involved - management, supervision and workforce - was the real confirmation of success.

The Author

Graeme Hogarth is a 30 year veteran of the pipeline industry, Email address: ghogarth@bigpond.net.au

BRIEF STATISTICS ON THE NORTH QUEENSLAND GAS PIPELINE

Pipelines

- mainline: 369.4 kilometre, 323mm diameter, from Moranbah to the Townsville Power Station;
- lateral: 22.6 kilometre, 273mm diameter from Woodstock to the Stuart industrial area;
- Moranbah gas compression and processing facility comprising four 2,650kW compressor units (each weighing approximately 150 tonnes) and a glycol dehydration unit
- facilities at Woodstock and the gas delivery stations at Yabulu and Stuart.

Project Statistics

- Pipeline carrying capacity: 42 petajoules/yr (PJ/a) with provision for future midline compression
- Moranbah Compression: 4 off 2,650 kW units and dehydration unit, capacity 24.8 PJ/a, capable of being doubled

Project schedule

- Commenced facilities construction: 1 Oct 2003
- Commenced pipeline construction: 13 Mar 2004
- Commissioned and completed mainline pipeline and facilities: 25 Sep 2004
- On line commercial service following Townsville Power Station commissioning: 7 Feb 2005

Fauna rescue statistics

- 793 snakes of 21 species
- 823 lizards of 33 species
- 1,491 frogs of 18 species
- 138 mammals of 14 species
- 6 turtles of 3 species
- 2 birds of 2 species

PROJECT DELIVERY: AN O&M PERSPECTIVE

Z Slavnic

Abstract

This paper provides an insight into the operation and maintenance issues that should have far more influence on new projects, from tendering through to design and construction.

Introduction

Operation and maintenance (O&M), as part of asset management, is increasingly being recognised by water utilities as an essential business function, hence it is being managed at a corporate level. This stems from the recognition that:

- O&M costs over economic life of assets are much greater than the capital expenditure required for their acquisition;
- there is the need for long-term investment planning of water infrastructure to meet future customer demands and ensure economic growth; and
- expenditure for maintaining and renewing existing assets needs to be managed in the most-cost effective way.

Projects in the water industry have usually been delivered by design and construct (D&C) contracts. Nowadays delivery methods which use relationship contracting, such as partnering and alliance arrangements, are increasing. Whatever the method of project delivery, it is felt that the emphasis is almost exclusively on project execution, with little attention given to the O&M needs of the end-users.

O&M - Out of Sight, Out of Mind

The costs associated with project delivery typically include design costs, expenditure required for construction works and supply of plant and equipment (construction costs), and other costs such as those for project management, etc.

The O&M costs of primary concern to end-users comprise labour costs for operation and maintenance, cost of chemicals, electricity costs, costs associated with residue handling and disposal, spare parts costs, etc. These costs are incurred as part of physical activities needed for day-to-day operation, maintenance and support of a facility during its in-service management.

The design and construction costs are just the tip of iceberg (see Figure 1). All we see during project planning are capital costs associated with its execution, but beneath the water line is the largest cost category - O&M for the simple reason that they apply across the economic life of a treatment facility (20 years or more), hence may be several times higher than the capital costs required for assets acquisition.

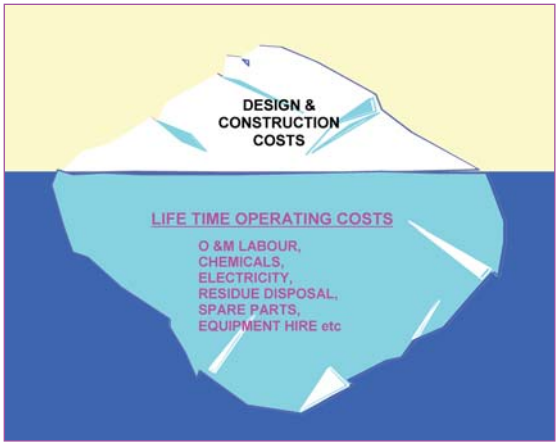

Figure 1. The O&M Tip-of-the-Iceberg Syndrome.

If O&M represents the largest cost category, one cannot but ask the question: "Why is so little attention then paid to O&M during planning?" There is certainly truth in the saying *Out of sight, out of mind.* The crux of the problem appears to be in today's economic environment where priorities are given to short-term over long-term interests.

Tender criteria should include operability and maintainabilty.

Water utilities are no exception, given that they operate under increasing budgetary pressures influenced by legislative and regulatory requirements (just consider the millions of dollars commercialised water organisations provide every year to their State Governments as dividends). Therefore, temptations are there to give too much focus on financial outcomes, not only during project works, but also during the operations period. These are shortsighted strategies, and are not recommended, as underspending in both areas leads to undesirable long-term O&M outcomes such as inefficient operation, premature asset deterioration, not to mention safety ramifications associated with day-to-day O&M activities. However, discussing the legislative and regulatory framework, is beyond the scope of this paper, but the following will address some practical approaches that should help to minimise O&M costs.

Tendering and O&M

On government projects contractors are usually selected using open or pre-qualified tendering. The manner of selecting the preferred tenderer (contractor) is transparent and may involve the application of a set of selection criteria. The criteria are project specific, but typically include:

- tender price;
- financial capability;
- construction methodology;
- technical details on process/equipment;
- contractor's past performance;
- safety;
- quality;
- environmental safeguards, etc.

Some water authorities go a step further. Namely, they require tenderers to submit a schedule showing major operations costs, such as electricity and chemical costs. Tenders are then compared, using NPV analysis, and the selected tenderer (contractor) is then required to guarantee these costs.

There is little doubt that the above is important, and when properly implemented would give end-users peace of mind that the best contractor for the project has been selected. However, this is mainly true for design and construction phases of the project, as the emphasis during tender assessment is clearly on the project execution.

It is believed that there is the need to improve the tender assessment in respect to operability and maintainability. This conclusion stems from the following:

- construction phase duration (inclusive of design) is a fraction of the facility's operating life (e.g. 1 to 2 years for construction compared to at least 20 years for the whole operating life);

- O&M costs during facility's operating life far exceed the capital expenditure required for assets project execution); and
- end-users' increasing interest in lowering O&M expenses and improving long-term investment planning.

Therefore, a new tender assessment criterion should be considered, ie the operability and maintainability criterion. It is believed this will stimulate designers and contractors to change their current practices and look for innovative and better solutions when it comes to O&M. The operability and maintainability criterion will encourage tenderers (in order to win the project) to list specific details on their design and demonstrate how the design facilitates O&M. This will then provide a solid basis for subsequent design development and ensure that the end-users' O&M needs are taken into account.

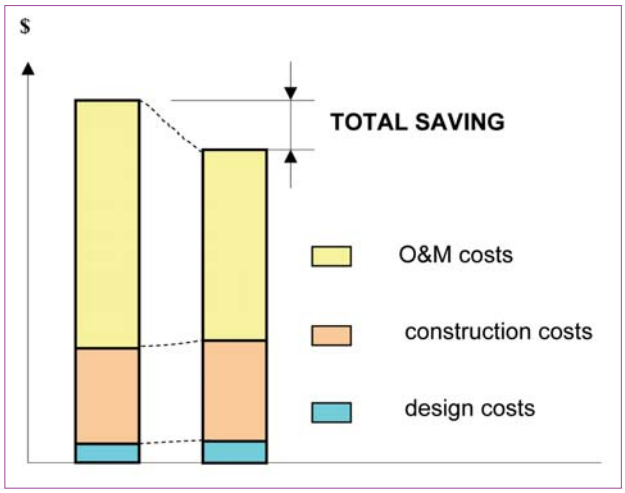

Figure 2. Impact of design on construction and O&M costs.

Design and O&M

Of crucial importance is that consideration of the O&M aspects begin as early as possible in the design phase of a project (actually, as argued above, it should begin during the tendering process). End-users' (ie operators') input is paramount, as operators know the equipment inside out, and can provide enormous contribution in arriving at design that is rational, economical and O&M friendly. This is commonly accomplished by design workshops and HAZOP studies, which are attended by all parties involved. These are the appropriate forums for assessing and developing design, and when coupled with the information provided under the O&M criterion, should ensure the incorporation of key O&M features in the final design.

It should be noted that there are always trade-offs between design and O&M that will affect the total life cycle costs of a treatment facility. The challenge is to arrive at the design that will provide the optimum mix of robust operation and long-term costs of ownership of assets.

The consequences of underspending on design are clearly undesirable. First, site works may be delayed and/or prolonged in order to deal with design deficiencies identified during construction stage. This results in increased overall construction costs, and can also have cost implications associated with liquidated damages. Second, design underspending also leads to undesirable long-term outcomes. These problems surface during the O&M stage when end-users become fully familiar with a treatment facility and realise the shortcomings in its arrangement, operation and functioning. From the author's experience the O&M shortcomings usually include the following:

- insufficient automation resulting in increased manpower and overtime work;
- inadequate equipment protection, in particular of pumps against dry running, which may cause significant damage to plant and affect process performance;
- insufficient control and monitoring by SCADA, which makes operation of treatment facilities difficult;
- selection of low-efficiency equipment (due to its lower cost), hence increased electricity costs;
- lack of cross-connections and stand-by equipment with resulting reduction in plant reliability;
- substandard support design, e.g. nozzles of pumps (and other rotating equipment) used as piping supports; this practice springs the pump causing misalignment and results in premature failure of seals and bearings with significant cost for their replacement;
- poor access for maintenance resulting in unnecessary dismantling of adjacent equipment - this is a major contributor to high maintenance costs;
- lack of equipment to facilitate maintenance such as lifting davits on high structures; this requires use of mobile cranes to lift items of only 20 kg or so;
- O&M documentation of generic nature with incomplete and ambiguous information;
- and the list goes on and on.

The impact of design on the total costs of construction together with the subsequent O&M stage, is graphically represented in Figure 2.

Figure 2 shows that with a bit more investment in design, construction costs will increase due to supplying better quality and more efficient equipment (e.g. AAA-rated motors), ensuring better access, etc. However, this may be off-set by smooth construction, as it is reasonable to expect that much less re-design and site re-work will be required when design is carried out thoroughly with proper review and verification. Nevertheless, the overall impact on design and construction costs would be relatively small, as they are not the largest cost category. This will be money well spent, as small reduction in annual O&M costs (the largest cost category) will result in significant savings over the life cycle of a treatment facility.

Construction and O&M

True D&C contractors in the water industry, not only in Australia, are a rare breed; most organisations either design or they construct. The most common approach across the industry is that the head contractors engage a consulting company (designer) to provide design services. Generally, head contractors usually lack in-house expertise to work with and oversee designers. This is particularly true when it comes to engineering disciplines such as process and electrical/control. Therefore, designers may be tempted to exploit this situation. However, head contractors usually have greater economic power than designing organisations.

The above is a problem in itself, as designers are then merely treated by contractors as a subcontractor. As such, disputes between the two parties frequently arise. This can have immediate consequences such as projects running late, budgets overrun, etc. However, this may also have long-term ramifications, most notably reductions in quality of work and inadequate arrangements for O&M purposes.

Further, cost reduction is a critical function of every business hence contractors may put too much emphasis on reducing project construction costs in order to improve financial outcomes. (It is worth noting that this is not only symptomatic to contractors, but to water utilities project teams as well, as they also have a budget to work with). However, indiscriminate and opportunistic cutting of corners is a recipe for disaster, with the pain being felt throughout the facilities' operations life.

The above is clearly counter to end-users' interests. But it is also not in the interest of contractors, at least not on a long-term basis. Namely, contractors primary concern is profitability, which is understandable as it guarantees future growth, etc. In order to make a profit contractors aim to utilise their resources effectively and efficiently to deliver projects:

- within budget;
- on time;
- to the specified technical requirements (including O&M requirements); and
- to the appropriate quality, safety and environmental standards.

But there is a constraint that needs to be recognised. All of the above must be accomplished within good client relationship (see Figure 3). It is widely acknowledged that this relationship can easily be soured during executions of projects. What is less obvious is that the relationship can go sour due to problems identified during the O&M period. Contractors, who are aware of end-users O&M needs and endeavour to meet client expectations in this respect, are no doubt better positioned to secure follow-on work.

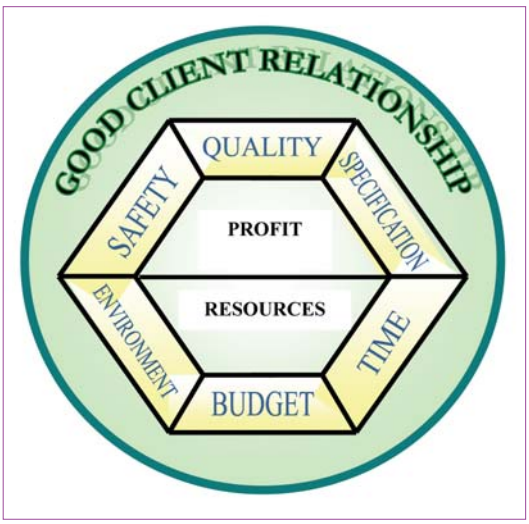

Figure 3. Project delivery and client relationship.

Conclusion

Rational and economical design of water/wastewater treatment works requires a thorough understanding of O&M requirements. Designers/contractors are responsible for design and construction, while O&M is the responsibility of end-users. Hence, contractors have little incentive to include features that will facilitate operability and maintainability. The solution must be worked out jointly by water utilities with the designers and contractors, as they are all part of the problem. Water utilities must take lead on this issue. They understand the complexities of the O&M issues involved, hence must ensure that O&M requirements are captured up-front, incorporated in design and delivered during the construction stage in order to get the best value for money, in the long term.

Water infrastructure is crucial from both economic and social viewpoints. Therefore, we must not look just to next year, but to the decades ahead. Anything other than that will result in fragmented and partial solutions with the price being paid by all of us.

The Author

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ALLIANCE PROJECT DELIVERY - BEGA VALLEY SEWERAGE PROGRAM BACKGROUND

W Stone, C Truscott, D Searle

Abstract

The Bega Valley Sewerage Program (BVSP), in rural southeast New South Wales, is a $60 million alliance formed in October 2003 between Tenix Alliance and the Bega Valley Shire Council (BVSC) to upgrade five existing sewage treatment plants and install greenfield sewerage systems for five villages in the region. Tenix Alliance will subsequently operate the ten facilities for BVSC until 2017.

The BVSP has developed unique project delivery concepts, which can easily be adopted by local utilities and the water industry at large. These include applying the commercial principles developed by the BVSC, incorporating environmental approvals and community engagement within the scope of works, and pioneering an innovative commercial framework.

The technology that the program has adopted is relatively new, and involves updating the existing treatment plants to Biological Nutrient Removal (BNR) facilities and in the villages using pressure sewerage systems in conjunction with Membrane Bio-Reactors (MBR) to replace individual onsite treatment systems. Whilst this is considered innovative from a technological perspective, the true innovation is in the project delivery.

Figure 1. The location of the works to be undertaken by the BVSP.

Part 1. The Bega Valley Sewerage Program (BVSP)

Under the BVSP, five treatment plant upgrade works are progressively being implemented in Tathra, Tura Beach, Bega, Bermagui and Merimbula (see Figure 1). They range in size from 4,500EP to 15,500EP.

Only minor works will be undertaken at Eden and for this purpose it is not considered a full upgrade.

The BVSP has achieved success by adopting an innovative approach to project delivery and innovative technical solutions.

These upgrade works range from complete plant replacement to process upgrades while the scope of work at all sites includes the development of reclaimed water reuse schemes.

The BVSP also includes greenfield sewerage collection, treatment and re-use schemes for a further five villages.

Commercial principles for project delivery

In March 2000 the Bega Valley Shire, encouraged by the then Department of Land and Water Conservation adopted in principle a 'concession style' contract approach to the program and appointed a project manager, Cashin Engineering and Management, to assist in the detailed development of the program, incorporating considerable community consultation. (See Cashin, Davis, Searle, Water, March 2004).

Subsequently tender documents were issued in December 2002.

Following this rigorous tendering and evaluation period, the largest ever capital expenditure program for the Bega Valley Shire was awarded in October 2003 to Tenix Alliance with Environmental Resources Management (ERM) as a sub-alliance partner to undertake the environmental and community aspects of the program. Tenix Alliance, ERM and the BVSC subsequently formed an alliance called the 'Bega Valley Sewerage Program'.

Prior to the award of the contract the BVSC consulted with Shire Councillors and the community to develop commercial principles for the delivery model. These are:

- The contractor will arrange environmental approvals, design and install all initial capital works.
- Council retains asset ownership, sets charges, and undertakes all billing functions and sets service levels and policies.
- The contractor will be responsible for operation of all sewage treatment facilities (10 years, + 5 year council option to extend).
- Council retains responsibility for all sewage collection systems.

This arrangement is relatively new within the wastewater industry with the 'program management' risk being transferred from council to Tenix Alliance.

Awarding a program of works to Tenix Alliance under the above principles has achieved significant economies of scale and consistency in design, procurement and delivery. For example, four of the five Sewage Treatment Plants (STPs) to be constructed are identical, resulting in significant cost savings for the BVSC and the community.

Integration of community and environment in the scope of works

The integration of the Environmental Impact Assessments (EIA) into the scope of works has streamlined the environmental approvals and has allowed the works to progress steadily without adverse affect on the BVSC or the community.

ERM, as a sub alliance, undertakes the EIA and community consultations associated with the BVSP.

The program culture encourages discussions regarding optimum pipeline routes, appropriate technologies and receiving water quality to ensure that all members of the program team (environmental, design, construction and operations) have opportunities to challenge convention.

The consultation strategy has also engaged the community and government agencies in the EIA process at various stages to ensure that all stakeholders are kept adequately informed.

This process has resulted in defined preferred solutions being presented in the EIA for approval. An example of a preferred solution for a village sewerage scheme would comprise of a detailed description of the collection system and treatment plant technologies, treatment plant site, reuse site and release point.

Developing the EIA with a high degree of community and statutory authority support, allowed the program to progress to the detailed design of a number of projects once the concepts had been finalised but prior to formal approval. In some instances this has allowed construction to commence as soon as environmental approval was received.

The first approval for the Tura Beach STP Augmentation was received within nine months of program commencement. Since that time a further seven environmental approvals have been received, each with minimal additional conditions of approval.

Innovative commercial framework

The Project Deed for the BVSP contains three 'contract forms' within the one contract, as developed by Cashin *et al.* This is quite a complicated arrangement designed to meet the specific needs of the Bega project and to maximise certainty for all parties involved.

The Bega contract was developed from first principles based on a detailed risk allocation and set of commercial principles.

The forms of contract/risk allocation included in the Bega document are:

1. Fixed price 'design and construct' for four of the new village sewage collection systems.

It was seen that there was minimal risk of change to the design of the network during the environmental assessment process, and therefore a fixed price could be obtained at tender stage. One collection system was seen to be more problematic, given the divided community opinion, and was combined with an existing treatment plant upgrade under modified alliance arrangements. Augmentation of one STP (Tathra) was also included in the fixed price works as this was the only project within the program with an existing environmental approval.

Installing "no fines" concrete blinding layer for Clarifier tank at Tura Beach, which also acts as a ground water drainage system.

2. Modified alliance for the sewage treatment plants (other than Tathra), one of the five collection systems and all environmental approval and community consultation works associated with the program.

The primary modification to the standard alliance process was that tenderers were required to submit a target cost with their tender, rather than developing it jointly with the client after contract award. This alliance approach was selected for these works because of the risk of changes to the treatment plant and effluent management arrangements during the environmental assessment process. The approach of splitting the fixed price and modified alliance works was adopted to meet Council's desire to maximise the certainty of cost at the tender stage. Linking the target cost to the risk/reward arrangements gave Council further comfort on 'best for program' decision making.

3. Operations and maintenance for the sewage treatment plants.

The extended operations and maintenance period (10 years +5 year Council option) passes the performance risk and maintenance cost risk over to the contractor. Council therefore has relative certainty in STP operations and maintenance costs for the next 10 to 15 years.

Council and Department of Energy, Utilities and Sustainability (DEUS) will provide all finance for the work. Ownership of all assets will remain with Council at all times. Council will stipulate the project outcomes and will retain responsibility for the customer interface and setting charges and policies and the like.

Conclusion

The Bega Valley Sewerage Program is breaking new ground in the delivery of this $60 million project. This program is combining relatively new technologies, adopting the commercial principles set by Council, integrating the environmental approvals and community engagement into the scope of works and pioneering an innovative commercial framework to deliver outstanding results for the Bega Valley Shire Council.

Part 2. The Engineering Component

The five STP upgrades

A range of solutions, including intermittent and continuous processes, has been developed by Tenix Alliance engineers for application on these STP upgrades, as listed in Table 1. In all cases emphasis has been placed on the reuse of existing infrastructure.

The Tathra and Tura Beach plant upgrades have both been completed.

The Tathra plant upgrade was completed within the first 18 months and included the construction of an 18 ML reclaimed water lagoon and installation of a new irrigation system so the adjoining golf course can use the reclaimed water from the plant. This new irrigation system replaces cumbersome manual irrigation systems.

In general, when completed, all plants will be fitted with fine screens, odour control, disinfection and sludge treatment facilities.

The five village sewerage schemes

Cobargo is the first of the five new greenfield sewerage schemes to be constructed and incorporates collection, treatment and reuse components. The remaining villages are to follow sequentially in the order of Wolumla, Candelo, Kalaru, and Wallaga Lake (as listed in Table 2).

The ultimate design for Cobargo and the other villages, including the location of the sewage treatment plant, was driven by the desire to optimise the beneficial reuse of the reclaimed water, preferably on community facilities. The system chosen for the villages is a combined scheme consisting of three components:

1. *Collection/reticulation system.*

A Pressure Sewerage System (PSS) involving the installation of a pumping unit on every property. Each pumping unit consists of a grinder pump that grinds the wastewater

Table 1. Scope of upgrade works.

Plant	Upgrade Description	Reuse/Release	Timing
Tathra STP	Conversion of two off 1000 e.p. Pasveer channels to 6200 e.p. continuous BNR treatment facility	Adjacent Golf Course	Complete
Tura Beach STP	Conversion of 2000 e.p. Bathurst box to 4500 e.p. continuous BNR treatment facility	Adjacent Golf Course & release via exfiltration trench	Complete
Bega STP	Replacement of circa 1930 trickling filter plant with 8000 e.p. SBR and inflow storage to cater for 11x ADWF inflow	Adjacent Dairy farm + Bega River Release	November 2006
Bermagui STP*	Conversion of 2000 e.p. Bathurst box to 6000 e.p. continuous BNR treatment facility	Adjacent Golf Course & ocean release	March 2007
Merimbula STP*	Existing 15,500 e.p. IDEA to be fitted with disinfection and upgraded control system	Adjacent Golf Course and Dairy Farm & Release via ocean outfall and exfiltration trench	December 2006
Eden STP*	Existing 8,000 e.p. Bathurst Box to be fitted with disinfection and upgraded control system	Adjacent Golf Course & Release via ocean outfall	December 2006

** Yet to be approved*

into slurry. The pressure created by the grinder pump is then used to push the sewage through pipes to the sewage treatment plant (STP).

2. *Treatment.*
An MBR sewage treatment plant.

3. *Reclaimed water management.*
An irrigation system to use the reclaimed water.

The new STP in Cobargo is being constructed at the Showgrounds, due to its proximity to the village and as the best community use for reclaimed water. The reclaimed water will be used in an irrigation scheme on the Showgrounds, replacing potable water as the primary source. In future, reclaimed water may also be used for toilet flushing and to provide a vehicle/float wash down facility.

Similar style arrangements are planned for the other villages except Wallaga Lake, which will use the existing sewage treatment plant at Bermagui.

Technology

The PSS in combination with an MBR is a relatively new concept within the wastewater industry. This innovative technology will reduce capital and operating expenditure for the Shire and produce a very high quality effluent for reuse.

In combining the technologies the capital and operating costs of BVSC are reduced by:

1. Reducing the amount of sewage pumping stations

A traditional gravity collection system would have required approximately 25 sewage pump stations to be installed across the five villages. By adopting PSS, Tenix Alliance was able to eliminate all but one of these pump stations.

Tathra STP upgraded to BNR.

2. Reducing plant size

The PSS is a sealed and pressurised system, which dramatically reduces wet weather infiltration. This made it viable to downsize the size of the STP, which now only has to be designed to cater for daily peaks, making membrane technology a more viable option.

3. Minimising harm to the surrounding environment

Minimal infiltration of stormwater has the advantage of lowering the risk of overflows due to extreme wet weather events and avoiding costly cleanups in the event of an overflow.

It also allows the use of smaller pipeline diameters installed at shallower depths in the collection system, reducing excavation and associated costs and minimising disruption during construction in existing residential areas.

Whilst MBR technology is not new, its use in sewage treatment plants in Australia is not widespread, with only a handful of plants completed to date, including facilities on Magnetic Island in Queensland and Victor Harbor in South Australia (currently being commissioned by Tenix Alliance). The design feature of the maximum hydraulic flow determining the required number of membrane units made it a good match with the PSS delivery system. With design peak flows limited to typical dry weather diurnal flow profiles, the cost of the process was significantly reduced, both in capital and in operating terms. The use of MBR has enabled high quality effluent to be reused for irrigation purposes.

Table 2. Greenfield sewerage schemes.

Scheme	Technology	Treatment Plant Site	Reuse Site/Release Point	Timing
Cobargo	Pressure Sewerage System (PSS) + 800 e.p. MBR	Cobargo Showground	Cobargo Showground + Narira	March 2006
Wolumla	PSS + 800 e.p. MBR	Wolumla Recreation Reserve	Wolumla Recreation Reserve + Adjacent Dairy Farm	May 2006
Candelo	PSS + 800 e.p. MBR	Candelo Showground	Candelo Showground + Candelo Creek	August 2006
Kalaru	PSS + 800 e.p. MBR	Kalaru Waste Transfer	Sapphire Coast Turf Club	October 2006
Wallaga Lake*	PSS	Transfer to Bermagui STP		March 2007

** Yet to be approved*

Conclusion

While the BNR technology utilised in the five STP upgrades is considered quite advanced, the pressurised sewer combined with MBR treatment followed by a re-use scheme utilised in the sewerage schemes for the villages is a relatively new idea. This concept was identified by Tenix Alliance as the best solution as the technologies were compatible and provided an opportunity to reduce capital and operating costs. The alliance framework enabled the Council to be included at every stage of the process and with rigorous community and environmental consultation the new concept was widely accepted.

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IMPACT OF MITIGATED FORESTRY ACTIVITIES ON TURBIDITY

A A Webb, A Haywood

Abstract

This paper compares the impacts on in-stream turbidity of selective native eucalypt forest harvesting in a paired catchment study. This study is the first to have been completed in the public forests of NSW since the introduction of Environment Protection Licences (EPLs) for forestry activities and has important implications for aquatic environments and water users located downstream of forestry activities.

The Middle Brother paired catchment study was conducted between 1994 and 2003. Harvesting and burning activities between December 1999 and July 2000 resulted in 20.7% forest canopy removal. There was a statistically significant impact on low-flow stream turbidity levels with impacted catchment values increasing from a pre-harvest mean of 3.3 NTU to a post-harvest mean of 8.5 NTU. This effect persisted for twelve months from the commencement of harvesting and declined thereafter. At high flows, total event turbidity and mean event turbidity levels increased during the immediate post-harvest period with high values in March 2000 and March 2001. High-flow values, however, declined to pre-harvest levels in subsequent events such that there was no statistically significant increase over the post harvest period. Event mean turbidity values were less than 20 NTU with the exception of one event during harvesting in March 2000. The majority of turbidity levels recorded during the study period were within the recommended values for protection of the aquatic environment and the range expected for unfiltered water supplies. This study has confirmed the potential impact of forestry activities on stream water quality and highlighted that soil conservation measures, particularly for roads, tracks and stream crossings, are essential to reduce the magnitude of possible non-point-source pollution.

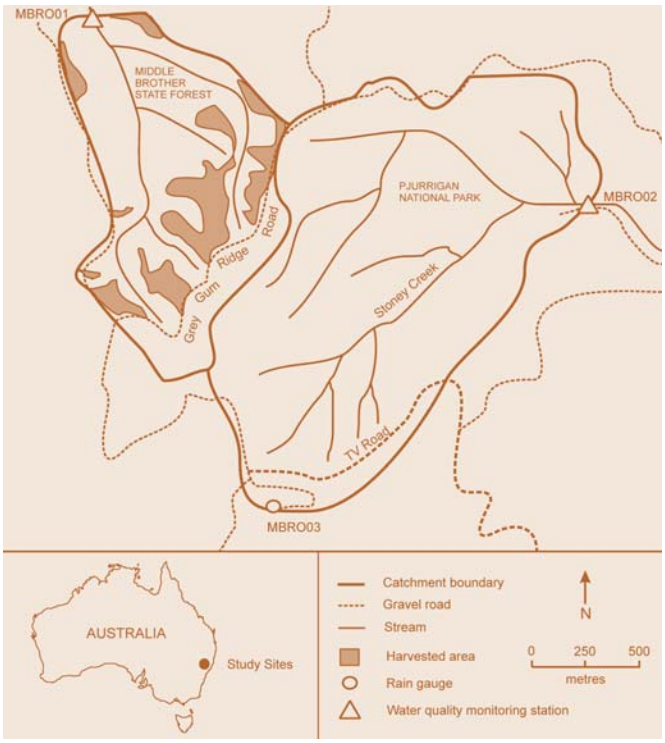

Figure 1. Location of the study catchments showing the extent of forest harvesting.

Assessing the effect of improved harvesting practices.

Key words: forestry, water quality, harvesting, turbidity

Introduction

In coastal New South Wales (NSW), drinking water supplies are often sourced from dams, rivers and streams within catchments comprising a mixture of different land uses, but usually including a forest component. Forests NSW manages a 3 million ha estate of forests for a range of purposes including timber production, flora and fauna conservation, water catchment protection and recreation activities. While the cleanest water and best aquatic habitat is generally sourced from native forests, some forest management activities, unless mitigating action is taken, have the potential to impact at a local level upon the quality and quantity of water that is available to downstream users and the aquatic environment.

Activities such as harvesting or the construction and use of forest roads can provide non-point sources of pollution due to soil compaction and disturbance, reduced groundcover conditions and/or exposure of bare earth or imported sediment (Riley, 1988; Croke *et al.*, 1999, 2001). If intense rainfall events occur soon after disturbance and there are uninterrupted linkages between sites of disturbance and drainage features increased soil erosion can result in elevated concentrations of suspended sediment and turbidity (Cornish, 2001; Croke and Mockler, 2001; Sidle *et al.*, 2004). In a forest environment managers cannot control hydrological events. However, it is possible to employ forest management and soil conservation measures that aim to either prevent or reduce soil erosion. Without soil conservation measures, turbidities in excess of 100 NTU would not be unexpected during forestry activities. In more extreme cases where direct linkages occurred unchecked, such as if an unsealed road were to drain directly into a stream, it is conceivable that localised stream turbidity during an intense rain storm could exceed 1000 NTU. Soil conservation measures introduce discontinuities in the landscape to prevent such direct linkages between sites of disturbance and drainage features. Other forest management techniques, such as locating roads and log landings away from streams, reduce the potential for the pollution of waters (Grayson *et al.*, 1993; Wallbrink *et al.*, 2002).

Forests NSW has been issued with five Environment Protection Licences (EPLs) by the NSW Environment Protection Authority (NSW EPA) for the carrying out of forestry activities on State forests and Crown timber lands. Licences can be downloaded from http://www.forest.nsw.gov.au/ifoa/une/default.asp. The object of each licence is to require practical measures to be taken to protect the aquatic environment from water pollution

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potentially caused by these activities. The conditions and practical measures contained within the EPLs are many and varied. These include:

- soil conservation measures for the design of bridges, culverts and causeways;
- appropriate drainage spacings on roads and skid tracks;
- seasonal harvesting restrictions;
- slope restrictions for harvesting and road construction activities;
- wet weather restrictions on the use of roads and log landings;
- mass movement hazard conditions;
- soil dispersibility conditions; and
- protection of drainage features by the use of filter strips and/or buffer strips.

While some of the individual conditions of the EPLs have been tested to some extent (Lacey, 2000; Walsh and Lacey, 2003), the overall effectiveness of the EPLs in meeting their objectives has not been tested. Furthermore, previous studies investigating the impacts of forestry activities on water quality (e.g. Cornish and Binns, 1987; Grayson *et al.*, 1993; Cornish, 2001) may not be applicable to native forest harvesting in NSW using present-day practices. This is because previous studies have either been conducted elsewhere (where species, climatic and harvesting conditions are different) or in the period prior to implementation of the EPLs, when the methods and intensities of harvesting were different.

To provide some feedback on the effectiveness of the EPL conditions, Forests NSW is implementing a water quality monitoring (WQM) program in over 30 small catchments in native forests and pine plantations. The objective of the WQM program is to determine if there is an identifiable impact on water quality from licensed forestry activities and if so, to quantify the level of that impact. The program was initiated in 1994 and modified in 1999.

The aim of this project was to investigate the impacts on in-stream turbidity of selective native eucalypt forest harvesting in a paired catchment study. This study is the first to have been completed in the public forests of NSW since the introduction of EPLs for forestry activities and has important implications for aquatic environments and water users located downstream of forestry activities.

Study Sites

The Middle Brother study comprised two catchments: an impacted catchment (MBRO01) 124.9 ha in area and a control catchment (MBRO02) 236 ha in area. (Figure 1).

The catchments are located in Middle Brother State forest and Pjurrigan National park, respectively and lie in the Camden Haven River catchment on the Mid North coast of NSW (Figure 1). Catchment geology is dominated by Late Triassic granitoid rocks with podzolic soils that are not dispersible, have high coherence and low transportability (Murphy *et al.*, 1998). Approximately 68.2% and 62.3% of the impact (MBRO01) and control (MBRO02) catchments have slopes of less than 20 degrees, respectively. Mean annual rainfall is 1790mm and vegetation in both catchments is dominated by *Eucalyptus pilularis* (Blackbutt). The forests have been managed for timber production for the last 70 years and are classified predominantly as Moist Blackbutt and Dry Blackbutt regrowth forests (Forestry Commission of NSW, 1989). The impacted catchment was most recently harvested in 1991.

Forestry Activities

The MBRO01 impacted catchment was selectively harvested using mainly Single Tree Selection (STS) with some Australian Group Selection (AGS) harvesting between 13 December 1999 and 31 March 2000. The aim of the operation was to harvest high quality sawlogs with a secondary objective to promote forest regeneration. Low intensity post-harvest burns were conducted during March 2000 and July 2000 to reduce fuel loads and promote regeneration of the eucalypt forest. Aerial photograph interpretation indicated that 25.8 ha or 20.7% of the tree canopy was removed during harvesting (Figure 1). Parts of the catchment not harvested were either too steep, inaccessible, pre-merchantable or excluded from harvesting due to regulatory conditions aimed at protecting water quality and threatened fauna and flora species. For example, riparian exclusion zones between 10 and 30 m wide were retained along each side of streams depending upon stream order.

Logs were extracted using a tracked vehicle and a main skid track (Figure 2) was constructed along each ridge.

Skid tracks radiated from each log landing parallel to the road then down each elongated section of the harvested area. The estimated total length of skid tracks is 2.5km. There is one gravel road through the

Figure 2. Skid tracks are used for the extraction of logs.

MBRO01 catchment, 1.5km in length (within MBRO01) located high in the catchment that was used for log haulage. Along the road there are seven drainage feature crossings. Three other tracks are located within the MBRO01 catchment with a combined length of 2.2km. The total length of roads, tracks and skid tracks within the catchment is therefore 6.2km. There is also a major road in the upper parts of the MBRO02 control catchment. It is 2.2km in length (within the catchment) and is used for access to the summit of Middle Brother Mountain.

Methods

Field and Laboratory Methods

Water quality monitoring stations were installed in November 1994 at the outlet of each catchment and maintained until May 2003, while a pluviometer (MBRO03) and manual rain gauge were installed and maintained in the headwaters of the MBRO02 catchment (Figure 3). Each monitoring station comprised a stage-activated automatic pump water sampler (ISCO model), a pressure transducer (Unidata model), staff gauge and data logger (Datataker DT50). Stream height was recorded at six-minute intervals while base flow and flood event water samples were collected over the period of record. Flood events were defined as having occurred when there was a rise in stream height of at least 0.12 m and 0.16 m at the MBRO01 and MBRO02 stations, respectively. Flood event samples were pumped from each stream on the rising and falling limbs of flood events. Water samples were analysed in the laboratory for turbidity using the nephelometer method (APHA, 1998). Cations, pH, conductivity and suspended sediment concentration were also measured at various times during the monitoring program. However, turbidity was the only variable measured for the entire period of record.

Statistical Analysis

To test for possible impacts of forest harvesting on turbidity, data were split into two groups:

- *Low Flow data* - results from samples that were taken during low flow periods, i.e. they were not taken during flow events; and
- *High Flow data* - results from samples collected during flow events, as defined for each site.

Low-flow analysis

Low-flow data from the impacted and control sites were sorted into pairs where the samples had been collected by the automatic pump sampler simultaneously at each site. Where samples had been manually collected by the field operator such samples were paired on the basis of the date they were sampled provided that flow conditions did not vary significantly during the day, such as if an event occurred. Logarithms were taken of the paired low-flow data and differences (IMC) between impacted and control sites calculated for each observation:

IMC=I-C, where I is Impacted site log(turbidity) and C is Control site log(turbidity).

A range of smoothing methods was examined to reduce trend and seasonal effects, and to remove serial correlation in the residuals. The means of the fitted values before harvesting (B) and after harvesting (A) were calculated. The difference (d) in the means (A-B) was also calculated and is the overall impact effect. The standard error and confidence interval for the mean difference (d) were then obtained using bootstrap re-sampling of the residuals by refitting the model and calculating the mean difference (A-B) 1000 times. The mean log(turbidity) for the control and impact sites was calculated. The average shift in log(turbidity) was calculated as a percentage change:

100[exp(m+d)-exp(m)]/exp(m)

Figure 3. Water quality monitoring station in the Middle Brother control catchment.

High-flow analysis

The original program design did not require the calculation of streamflow at each site such that rating curves were not developed for the water quality monitoring stations. Therefore, to evaluate any impacts at high-flows, it was necessary to establish variables to be used as a surrogate for comparison of control and impact site high-flow turbidity levels. Turbidity data were used to calculate the following for each event at the control and impact sites:

- *Total Turbidity* was calculated by integrating the area under the time series plot of turbidity (i.e. turbidity x time).
- *Mean Turbidity* was calculated by dividing *Total Turbidity* by the duration of the event.

These data were then used to determine IMC values for each calculated variable, i.e. the value from the Impacted site (MBRO01) minus the value from the

Table 1. Summary of low flow turbidity for various periods at the impacted (MBRO01) and control (MBRO02) sites. Values reported are means ± 2 standard errors.

Period	MBRO01 Low flow Turbidity (NTU)	MBRO02 Low flow Turbidity (NTU)	No. Samples
Pre-harvest	3.3 ± 0.7	3.4 ± 0.7	193
14/12/99 to 13/12/00	10.7 ± 5.6	4.2 ± 0.7	18
14/12/00 to 13/12/01	7.7 ± 7.0	2.9 ± 1.0	9
14/12/01 to 30/4/03	5.2 ± 1.5	4.3 ± 1.5	10

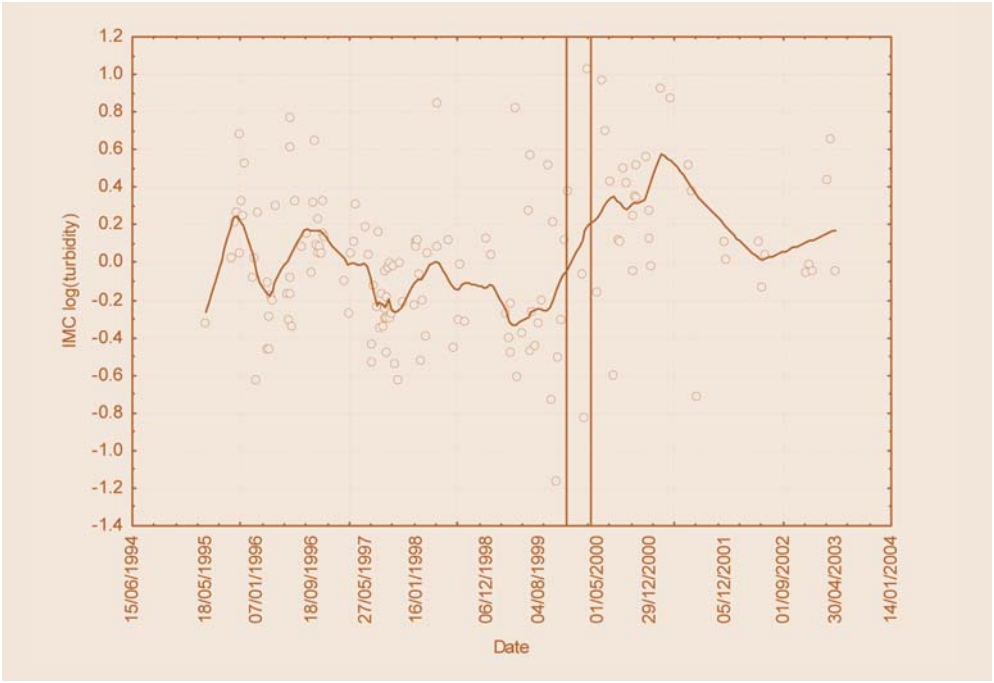

Figure 4. Time series plot of impacted minus control (IMC) site log (turbidity) values and loess fit (span 0.1) at low-flows. The vertical lines represent the period of harvesting.

Control site (MBRO02). To statistically evaluate any possible impacts of forestry activities, a distribution free permutation t-test was conducted between the pre- and post-harvest IMC values for each of the calculated variables.

Results and Discussion

Low-Flow Turbidity

There were 117 and 37 paired observations prior to and after the commencement of harvesting, respectively. Logarithms were taken of the paired data and IMC values calculated. A loess smoother was chosen as the most appropriate and fitted to the IMC data with a span of 0.1 (Figure 4). The loess fit of IMC values was variable in both the pre-harvest and post-harvest periods, but the trend suggests that low-flow turbidity IMC values fluctuated between positive and negative values pre-harvest, but were mostly positive post-harvest. The positive low-flow turbidity trend was consistent for at least 12 months post-harvest, after which there was a steady return to zero (i.e. no impact).

The mean of the fitted values before harvesting was -0.10 while after harvesting the mean of the fitted values was 0.55. The difference in the means (A-B) is the overall impact effect (d) and in this case was calculated to be 0.65. The result of 1000 bootstrap samples gave a standard error of 0.14 and 95% confidence limits of 0.40 and 0.92. The mean log(turbidity) for the control (MBRO02) was 1.11 and showed little change between periods. The average shift in log(turbidity) was calculated to be 92.5% with 95% confidence limits of 48.7 and 151%, indicating that the increase in low-flow turbidity post-harvest was statistically significant. In reference to the absolute change in low-flow turbidity, the mean low flow turbidity of the paired data sets was 3.3 and 3.4 NTU at MBRO01 and MBRO02 respectively in the pre-harvest period. In the post-harvest period the mean low flow turbidity of the paired datasets was 8.5 and 3.9 NTU for the MBRO01 and MBRO02 sites, respectively.

The MBRO01 impacted catchment low-flow turbidity values remained elevated (at around 8.5 NTU) for a period of at least 12 months following harvesting, after which the values returned to the pre-harvest level (Table 1). The default turbidity trigger values to protect aquatic ecosystems in upland rivers of slightly disturbed ecosystems in southeastern Australia are 2 to 25 NTU (ANZECC, 2000). The guidelines also state that most good condition upland streams have low turbidity but that high values may be observed during high flow events. It appears that while low flow turbidity values increased post-harvest at MBRO01, the mean values were within the default accepted values for protection of the aquatic environment. The low-flow values were also within the range expected for unfiltered water supplies (ADWG, 1996). While there may have been a statistically significant increase in low-flow turbidity post-harvest, the increase in absolute terms was minor. Nevertheless, these results suggest that further work is required to determine thresholds of disturbance that are acceptable to aquatic organisms during low-flow periods.

High-flow Turbidity

High-flow events were paired between the impacted and control sites where an event occurred at both sites simultaneously, and where

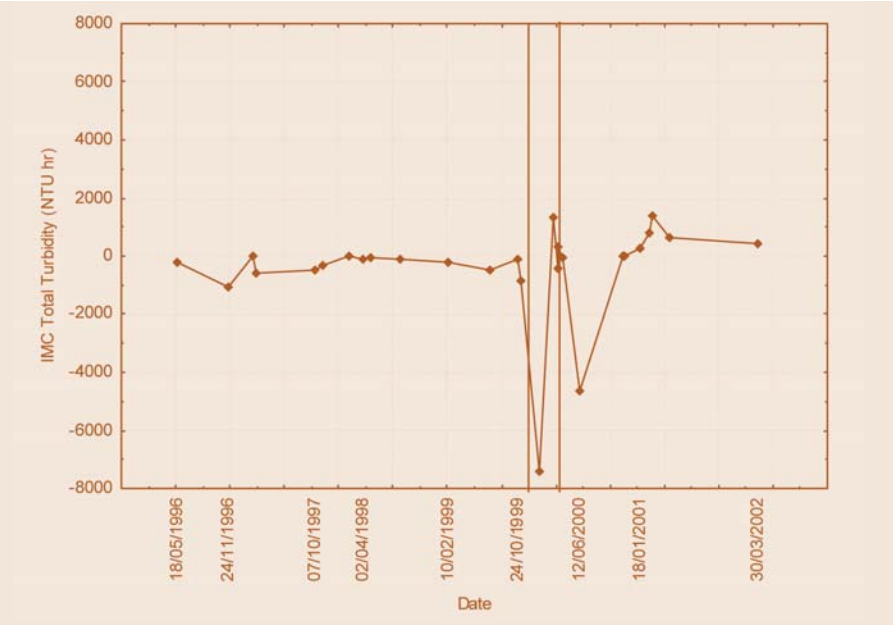

Figure 5. Impacted minus control (IMC) site Total Turbidity values (integrated NTU per hour) by high-flow event. The vertical lines represent the period of harvesting.

adequate sampling data were collected at each site. Sampling was adequate to allow calculations based on 14 paired events pre-harvest and 13 paired events post-harvest.

Total event turbidity values at both the MBRO01 impacted site and MBRO02 control site were variable in both the pre- and post-harvest periods as would be expected due to natural variability in event rainfall and sediment loads. IMC total event turbidity values were reasonably consistent in the pre-harvest period but showed some variability in the post-harvest period (Figure 5).

Notably, events 15 (January 2000) and 20 (June 2000) were much lower, while events 16 (March 2000) and 24 (February 2001) were higher. There was, however, no significant difference between the pre- and post-harvest IMC values for total turbidity (p= 0.73).

Mean event turbidity values at both sites were variable in both the pre- and post-harvest periods. In the pre-harvest period the majority of IMC mean turbidity values were negative but exhibited some variability between events (Figure 6).

In the post-harvest period the first event (Event 15, January 2000) had a lower value than any of the pre-harvest IMC mean turbidity values. The second event following the commencement of harvesting (Event 16, March 2000) had a higher IMC mean turbidity value indicating there was a detectable impact during harvesting. The following four events exhibited a decline to negative IMC mean turbidity values, suggesting that any impacts of harvesting were short-lived. There was again a rise in mean turbidity IMC values in November 2000 (Event 21), with further positive values for events 23-25, after which the values were again negative. There was no significant difference between the pre- and post-harvest IMC mean turbidity values (p= 0.15). Furthermore, the majority of event mean turbidity values were low in absolute terms and typically lower than 20 NTU for the period of record at the MBRO01 impact site. With the exception of the second event after harvesting had commenced (mean turbidity 51.4 NTU) these values were within the default trigger values for turbidity in lowland streams (ANZECC, 2000). All mean event turbidity values were within the expected range of turbidity in unfiltered water supplies (ADWG, 1996).

Conclusions

Selective harvesting of the MBRO01 catchment using Environment Protection Licence (EPL) conditions resulted in a minor but statistically significant increase in low-flow stream turbidity levels, though far less than would be expected from uncontrolled harvesting. This effect persisted for at least twelve months from the commencement of harvesting activities and declined thereafter. At high flows, total event turbidity and mean event turbidity levels increased during the immediate post-harvest period punctuated by at least two high values in March 2000 and March 2001. Event total and mean turbidity values, however, declined to pre-harvest levels in subsequent events such that the increases experienced were not statistically significant.

This paired catchment study has confirmed that there is a potential for forestry activities to impact upon the erosion and transport of hillslope sediment resulting in effects on in-stream turbidity levels. Best management practices (BMPs), such as those contained in EPL conditions, can be effective in reducing the effects. The harvesting period coincided with the period

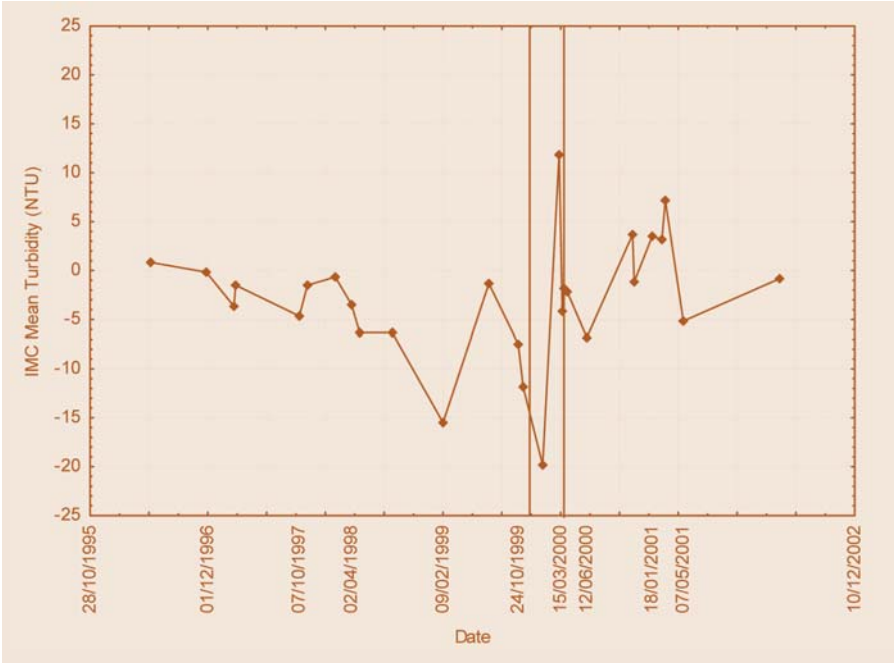

Figure 6. Impacted minus control (IMC) site Mean Turbidity values (total divided by event duration) by high-flow event. The vertical lines represent the period of harvesting.

of increased low-flow and high-flow turbidity levels at Middle Brother. Given that roads and tracks are the predominant sources of sediment in managed forests it is important to ensure that breaches of the conditions are minimised, promptly identified and rectified to reduce potential impacts, especially during harvesting and log haulage activities.

Water quality monitoring is an important component of sustainable forest management. Ongoing programs managed by Forests NSW are monitoring stream flows, turbidity and suspended sediment concentrations in a number of forests throughout NSW. Results from these programs and the Middle Brother study reported here should be utilised within an adaptive management framework. Modification of management practices and revision of the EPL conditions can then take place to ensure the quality of water is suitably protected downstream of forestry activities.

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Water Business

PROCESS CONTROL & GENERAL NEWS

NEW PRODUCTS FOR FLOWMETER RANGE

MACE has introduced a new range of products to its extensive range of flow meters. The Dynasonics non-invasive clamp-on flow meters are a low cost solution for many industrial discharge, water, wastewater and irrigation applications.

Glen Murphy, Managing Director of Hydrometric Consulting Services, used the TFXP portable unit for his work in many different applications:

"We used the portable unit to measure flows in different types of pipes (stainless steel, PVC, DICL and thick wall hose of diameters ranging from 25 mm to 400 mm). The unit was used primarily to verify the accuracy of on-site flow meters for short periods of time (5-10 minutes) with different fluids ranging from sludge, to raw effluent and clean water".

"The unit proved to be very accurate with readings within 1-2% of existing magnetic flow meters and was extremely easy to set up and program. The transducer mounting bands were easy to use and the instructions were very clear."

For additional information call (02) 9980 2692 or see www.mace.com.au

RF ADMITTANCE LEVEL SENSORS

Efficient level measurement in storage, process and buffer tanks in the food, petrochemical and chemical industries poses several challenges. These include the need for on-site calibration (empty and full) once the device is fitted to the vessel, special tank design to mount the device, measuring rapid level changes, and viscous media build-up among others.

Endress+Hauser's Liquicap M is a next generation RF admittance level measurement instrument that addresses these issues and also incorporates a host of other innovative features.

Liquicap M is ideal for the food industry - it comes with FDA (Food and Drug Administration) approval and meets EHEDG's (European Hygienic Equipment Design Group) aseptic requirements. The probe can be supplied factory calibrated for conductive liquids enabling simple and fast commissioning. OEMs no longer need to calibrate or empty and fill the vessel prior to fitting the probe - literally fit-and-forget. Build-up of viscous media on the probe can drastically reduce measurement accuracy negatively impacting inventory management. To address this issue, Endress+Hauser has incorporated new cutting-edge algorithms into Liquicap M to accurately and automatically compensate for build-up on the rod or rope.

Level measurement in the petrochemical industry poses a different set of challenges especially when the interface level of immiscible liquids need to be measured. Liquicap M's capacitive probe not only accurately measures the interface layer in conductive/non-conductive liquids, but it can also measure emulsion levels, something that is not possible with other even more expensive technologies.

The extremely fast response time makes Liquicap M particularly suitable in smaller tanks where rapid level changes occur. Since there is no 'blocking distance', as is standard with ultrasonic and microwave level measuring devices, the measurement is made from the end of the probe to the process connection, from the tank bottom to the top. This makes tank configuration and size immaterial to Liquicap M's ability to measure levels accurately.

In the rare event of a failure in the transmitter electronics, the module can be simply and quickly replaced without the need for recalibration since calibration data is stored in the sensor head, and can be automatically uploaded into the transmitter on replacement.

Contact phone 1300 363 707, email info@au.endress.com, www.au.endress.com

SEPTIC TANKER RECEIVAL STATION

The disposal of tankered septic tank wastes at wastewater plants has traditionally been a problem for plant operators. To tackle this problem, Contra Shear Technology has supplied its first septic tanker receival station to Wide Bay Water.

This complete package, including flowmeter, control valve, fully automated controller and self contained screen, allows the council to control and measure the discharges to their wastewater plant.

Water Business

Water Business aims to keep readers alert to business news and new product releases within the water sector. Media releases should be emailed to Brian Rault at brian.rault@halledit.com.au or Tel (03) 8534 5014.

Environmental & Process Technologies

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DR5000
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For more information please contact
Environmental & Process Technologies
Division of Biolab
Australia 1300 735 295 environmental@aus.biolabgroup.com
New Zealand 0800 422 469 environmentaltech@nzl.biolabgroup.com

The tanker connects to the system using a standard Kamlock fitting, but before the plant can be operated and the tanker discharged, a unique access code is required. This allows any discharges to be measured and accurately charged to the tanker operator. All material above 5mm is removed and dewatered before the filtrate flows to the sewage plant inlet.

The system is designed to allow the tankers to discharge within 30 minutes.

Contact Contra Shear Technology, Tel (02) 9427 1279, www.cstechnology.com.au

FULLY AUTOMATIC SELF-CLEANING LIQUID FILTRATION SYSTEM

The Zero Gravity Filters (ZGF) EasyClean line is an industrial range of fully automatic self-cleaning liquid filtration systems designed for absolute ratings from 12 to 400 microns and flowrates up to 600 litres per minute.

The ZGF EasyClean line offers efficient, consistent filtration combined with very low maintenance requirements and is suitable for applications such as the protection of heat exchangers, spray nozzles or analytical equipment, and for the filtration of process water, machine coolants, pump seal water, flume water, river intake and vehicle paint lines.

The modular ZGF EasyClean line can be extended as required.

The key component in ZGF EasyClean systems is the spiral coil filter element made from aerospace grade stainless steel. Raised nidges on the surface of the coil ensure precise micron ratings. During backwash, a supply of clean liquid travels in a reverse direction from the inside to the outside of the element. This reverse flow forces the filter coil to open evenly from top to bottom, and causes a 'shimmering' effect, resulting in a 100% clean in the shortest possible time with a minimal amount of liquid. A typical backwash sequence is completed within two seconds and returns the filter element to its clean differential pressure every time.

The ZGF EasyClean line has minimal moving parts through simplicity of design, resulting in very low maintenance and operating costs. The filter elements are readily accessible and are interchangeable between micron sizes. The filter coils are very durable - they come with a 5-year guarantee - and have a favourable wear characteristic resulting in an improvement in filtration efficiency and thus progressively better protection of your equipment.

The modular, PLC controlled ZFG EasyClean line provides an autonomous filtration solution for uninterrupted, 24/7 filtration in a compact package.

Contact Roland van Amstel, National Sales Manager, Mob 0438 077 572, Email: water@imatech.com.au

NEW PROGRAMMABLE AUTOMATION CONTROLLER

Control Microsystems Inc (CMI) has introduced a new programmable automation controller - the most powerful member of the SCADAPack Series for demanding applications.

Designed to meet industry demands for high-speed distributed control and automation, SCADAPackES is an advanced RTU and process controller that provides the ideal solution for applications requiring small to medium I/O counts, high-speed time stamping and data capture.

Peter King, Manager, Control Microsystems Asia Pacific commented "This product is the latest in the CMI progressive SCADAPack line that offers high industry benchmarks in speed, reliability and high performance. A three-year warranty and a responsive customer support program back all our SCADAPack products."

Packaged with multiple communications options, SCADAPackES is suitable and cost effective for a variety of applications in the areas of oil and gas production and distribution, mining, water-wastewater, electrical substation monitoring and control, and more.

Control Microsystems has a technology centre in Newcastle, NSW, and an Asia Pacific marketing office in Melbourne, and specialises in the design, manufacture and supply of programmable RTUs, intelligent sensors, gas production automation, and PLC products.

Contact Peter King, (03) 9249 9562, Mob 0439 825 011, pking@controlmicrosystems.com, www.controlmicrosystems.com

MWH - MOVING AHEAD WITH PROGRESSIVE CAVITY PUMPS

In 1997, the NSW government announced the Priority Sewerage Program (PSP). This was a major initiative introduced by the government to address the environmental and public health problems from 53 unsewered areas in Sydney and the Illawarra. In order to successfully deliver the program, Sydney Water formed an Alliance with MWH Australia, Manidis Roberts, John Holland and United KG, known as the PSP Delivery Team.

MWH is proud to be part of the PSP Alliance as the Delivery Team's approach redefines the delivery of major public infrastructure through an integrated multi-disciplinary approach from concept design through to delivery. It involves innovative uses of technology and management systems and strives for outstanding performance targets.

Four towns that are part of Stage One of the PSP are Coalcliff, Stanwell Park, Stanwell Tops and Otford Sewerage Scheme, and they are all located about 24 kilometres to the north of Wollongong and have a population of around 2,330 people.

These towns were nominated as a priority area because the onsite sewerage systems that serviced the towns were adversely affecting local waterways and posed potential public health risks. The towns are located close to environmentally sensitive areas such as the Illawarra escarpment, Royal National Park, Coalcliff and Stanwell Park coastlines and Port Hacking waterways.

The Scheme involves a combination of sewerage reticulation systems and pumping stations. A pressure sewer system is used in Coalcliff, Stanwell Park and Otford to address the unique geographic features of these three towns. A conventional gravity system was built in Stanwell Tops.

Sewage will be collected from Coalcliff, flow to Stanwell Park, collected there and then transferred to Otford. Sewage is to be collected from Otford and Stanwell Tops and then pumped via Helensburgh and onto the Cronulla sewage treatment plant.

Progressive cavity pumping installations have been installed at all four sewage pumping stations in this scheme. The new installations are largely similar with ground level pumping houses, below ground storage of raw sewage and separate emergency storage to prevent any dry weather overflows in case of station failure.

Macerators have been fitted on the suction side of each pump to protect against blockage from large or fibrous matter.

A view of Stanwell Park which forms part of the PSP.

Progressive cavity pumps offered many advantages for this scheme:

- First, a reduction in the number of pump stations was feasible because of the higher discharge heads capable with this type of pump.
- Above ground installations are possible with the suction lift capability of the pumps. This has resulted in a clean and dry maintenance environment. The pumps self-prime each time they are called to run with an additional water feed to maintain effective lubrication of the stator/rotor interface as the air is expelled into the rising main.
- The positive nature of the pumps result in consistent flows that are largely insensitive to sliming in the main that would cause deterioration of performance of other pump types.
- Reduced overall capital costs were delivered as the transfer main pipe diameter could be reduced, trading off slightly higher friction losses against the pipe installation cost. The rising main for the Stanwell Park station has a very long bore to Otford and the cost of the bore was strongly influenced by the pipe diameter so using this approach delivered significant savings.
- Special abrasion-resistant coatings to the pump rotors where chosen in concert with low operating speeds to deliver a low maintenance station that will continue to pump sewage efficiently for many years to come.

For further information about Progressive Cavity Pumps, please contact MWH's Ivan Lowe, Technical Manager for the PSP Alliance Team, ivan.lowe@sydneywater.com.au

COPA WATER EXPANDS ITS ACTIVITIES

Earlier this year, Copa Water Pty Ltd was formed when CDS Technologies Limited combined its Australian

Stormwater (CDS) and Wastewater (Triwater) businesses.

The name Copa Water provides an international branding synergy with CDS's highly successful UK companies of Copa, Copa Cornwall, Copa MBR and Copa Waste Water Controls.

Copa Water provides a wide suite of innovative stormwater, sewer overflow, wastewater and water reuse products from Australia, Europe, UK and the USA.

CDS Technologies has been in business since 1994 providing environmental solutions, primarily in stormwater. In particular, this company is one of the acknowledged leaders in the treatment of stormwater in Australia and internationally. CDS has designed, supplied and in many cases installed over 5,000 CDS stormwater traps worldwide over the last 10 years, while also extending its advanced screening technology into sewer overflow and wastewater treatment applications.

Triwater Australia is a specialist design and construct wastewater treatment company, which has built over 550 wastewater treatment plants over the past 23 years mainly based on its successful hybrid biological nutrient removal (BNR) process.

Plants have been installed to cater for populations from 50 people to in excess of 40,000 and all plants produce an exceptionally high effluent. Triwater has been at the forefront of sewer mining and water reuse projects throughout Australia.

Recent projects completed by Copa Water include Cooktown WwTW, Qld $4.0m; Barwon Prison WwTW and Reuse, Vic $6.0m; Cabramurra WwTW, NSW $2.3m; Normanville Upgrade, SA $1.2m; Burwash Village, UK $1.2m; Sellindeg WwTW, UK $2.5m; Kinross Estate, NSW - supply of 31 CDS stormwater GPTs.

The two NSW offices were recently moved to a larger centrally located office in Auburn and on the 1st of September a new website was launched that covers the full range of products and services provided by Copa Water, www.copawater.com.au.

Tel NSW (02) 9645 8000, Vic (03) 9781 7800.

PRE-ASSEMBLED DUAL SERVICE METER BOXES

AllFlow Supply Company, in conjunction with Reliance Worldwide, has introduced the Dual Service Meter Box - 'DMB'.

It has been developed to improve uniformity, remove the chance of potable and non-potable interconnection, and reduce the installation costs for dual meter services.

The DMB can be used in two applications: for dual services to a single property (potable and recycled meters), and as a dual service installation servicing two adjacent properties (2 x potable meters).

Supplied with poly pipe connectors, the DMB provides for controlled inlet connection points for mains layers, and two controlled outlet connections for house connections.

No further fittings are needed. Just connect the poly pipe to the fittings and it is ready to go. Every box assembly is water pressure tested to 1600kPa before it leaves the workshop.

The DMB can be supplied complete with Reliance water meters or without, allowing the authority to issue their own should they require.

Features include:

- full DZR brass components;
- colour coded fittings and ballvalves denoting potable and recycled supply pipes;
- lockable inlet ball valve;
- standard meter connection couplings;
- extendable coupling allowing easy fit of meter;
- box base included to ensure stable footprint;
- fully serviceable *in situ*.

Benefits:

- long service life components;
- reduced installation costs;
- fast service connection and meter installation/replacement.

Flow restrictors can be fitted.

Contact AllFlow Supply Company, Tel (07) 3390 7166 or email info@allflowsupply.com.au

NEW PACKAGE POLYMER SYSTEMS

Acromet Australia has released a range of fully automated and portable polymer systems which are used in water and wastewater applications where flocculation is required.

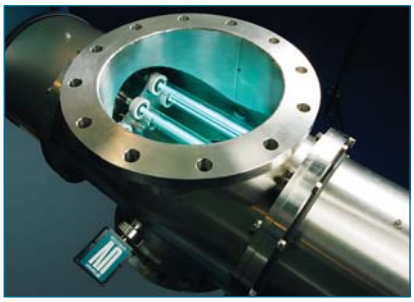
Both liquid and powder systems are available, and features include skid-mounted design with tank and all associated equipment including controls. A wetting cone assembly offers mixing with concentrations up to 0.5% without 'fish-eyes'. Water intake and feed control is automated via mimic panel offering the operator the opportunity to view the operation of any part of the system. The systems are available with stainless steel tank or polypropylene tank arrangements offering excellent chemical resistance combined with a light weight, self-contained package.

The system is designed for polymer; options are available for make-up and batching systems for lime, PAC & bentonite.

Contact Acromet, Tel (03) 9544 7333. Email: chemex@acromet.com.au, www.acromet.com.au

BUGS KILLED BY MEDIUM PRESSURE UV STAY DEAD

It is well known that bacteria and other microorganisms contain enzymes that can repair UV-damaged DNA, a process known as 'reactivation'. Some of these enzymes need visible light to perform the repairs ('photoreactivation'), while others can do so without light (known as 'dark repair'). Photoreactivation is generally quicker than dark repair, but both of these phenomena pose obvious problems for operators of UV disinfection plants.



There are two main types of UV disinfection technology currently in use - low pressure and medium pressure. Low pressure UV lamps contain mercury gas at a low pressure which, when excited by an electrical charge, emit UV light at 254nm. Medium pressure lamps contain mercury gas at much higher pressures. These lamps produce UV of a higher intensity and over a broader range of wavelengths than low pressure lamps.

Recent research on the process, however, has produced interesting new developments. When comparing photoreactivation of *E.coli* DNA after exposure to UV wavelengths emitted by low and medium pressure lamps, independent researchers have shown that the DNA underwent extensive repair following exposure to UV from low pressure UV lamps, but virtually none following exposure to UV from medium pressure lamps.

The researchers concluded that it was the broad UV output of medium pressure lamps, between 185-400nm, that has this desirable effect. By emitting UV over a wide range of the UV spectrum, medium pressure lamps appear to damage other intracellular molecules, such as enzymes, in addition to DNA. It is this damage which seems to permanently inactivate the cells' DNA repair mechanisms. Low pressure UV lamps, on the other hand, produce only a single UV peak at 254nm which only affects DNA.

The implications of these findings are far-reaching. For any industry where UV is used to disinfect water or effluent, the operator needs to be sure that the treatment is permanent. This is especially the case when the treated liquid will subsequently be exposed to light. The researchers suggest that medium pressure UV could therefore provide better protection against photoreactivation if UV treatment occurs prior to any process units in which water is exposed to light for even a short time (30-180 minutes). According to their study, "Using low pressure UV in this type of situation should be avoided, since repair occurs rapidly following exposure to light."

Applications affected by these findings are wide-ranging and include municipal or bottled drinking water, wastewater and effluent, industrial process water, rinse or wash water in the food industries, fisheries and swimming pools. By providing permanent microbial deactivation, medium pressure UV offers peace of mind, something low pressure UV does not do.

Contact Michael Bambridge, Contra-Shear Technology, Tel: (02) 9427 1279, Email: info@cstechnology.com.au, www.cstechnology.com.au

HIGH SPEED AERATORS AND MEASURABLE DO READINGS

The need to increase oxygen input in lagoons or oxidation ditches to a measurable level to suit process demand or compliance O_2 residual requirement is being satisfied in many locations by EPCO Australia/EEE floating aerators.

The floating, high-speed draft tube style aerator can be supplied with several options to solve numerous site specific problems. Amongst these are issues associated with shallow membrane or clay-lined lagoons, which can be overcome by the addition of an anti-erosion disk that enables horizontal inflow to occur. Depending on motor size these aerators can be operated in liquid depths as low as 1.5m.

Smell and health concerns generated by high BOD levels in stagnant waterbodies are major problems for both industry and government. These factors and the need for water recycling are driving the requirement for water bodies to be better managed.

Oxygen feeds the aerobic bacteria that reduce BOD levels thus purifying wastewater ready for further treatment in the case of recycling or to achieve a healthier water environment.

There are two critical design factors for aerators, namely oxygen input and mixing capability.

The EEE floating draft tube design has various design features that allow us to optimise the oxygen input or to achieve complete mix conditions, in shallow or deep liquid, depending on the primary requirement.

In the case of oxygen input, the greater the quantity of flow pumped, the higher the rate of oxygen transfer. To perform this function efficiently requires the entire unit to be designed for streamlined flow and reduced friction loss. Where complete mixing is the primary goal, such as in industrial wastewater or suspended sludge, the ability of the aerator to keep solids in suspension is related to the pumpage that is produced per unit of basin volume. In the case of the EEE design, oxygen and fine scale turbulence are distributed throughout the liquid by the operation and movement of secondary vortices. The secondary flow system is induced and sustained by the primary flow system.

Power consumption is also lower than other more conventional aerators as the hydraulic shape of the draft tube requires less motor power to overcome friction losses per kg of oxygen input.

Installation and maintenance handling of the aeration unit need no longer require a crane. EEE have designed a skid attachment that enables the unit to slide down a runway into and out of the water body. The structural frame is made of tough, corrosion-resistant fibreglass with the additional maintenance benefit of no underwater bearings.

Portability is another feature that is attractive to some clients. Only three mooring cables and a floating or submerged power cable need to be disconnected to enable the unit to be lifted on to transport for transfer to another location.

High speed floating aerators offer very effective solutions for the management of both large and small water or wastewater storages.

The EPCO Australia and EEE partnership has over 60 years of accumulated experience in satisfying the demands of the wastewater industry for effective and efficient surface aeration.

Contact: EPCO Australia, (07) 3279 3276, www.epco.com.au, Email: grantc@epco.com.au

NEW OPTICAL OXYGEN SENSOR

The accurate and continuous measurement of the concentration of dissolved oxygen (DO) is critical in water management applications such as sewage treatment and water treatment plants and also in fish farming and monitoring river and surface water.

Endress+Hauser's new optical oxygen sensor, Oxymax W COS61, offers significant benefits in terms of long-term stability with minimal maintenance. The heart of the sensor is an optical lens containing fluorescence-active molecules and, when excited by a short-wave light pulse, the molecules emit a red light, the intensity and duration of which depends on the DO concentration. No liquid flow is required as the optical sensor takes accurate measurements even in still water.

Delivered as a pre-calibrated sensor, COS61 can be immediately installed at the measuring point without running-in time or on-site calibration. Self-monitoring alerts the user when a sensor cap needs replacement, typically every 14 months or more, a process that takes a few minutes.

With the new cap in place, the sensor may be easily calibrated in air. Apart from a measuring range of 0 to 20 mg/litre, COS61 also features digital signal processing which allows impressive cable lengths of 100m to the transmitter. This allows the transmitter and operator to be situated at a much safer distance away from the process being monitored.

The older amperometric diaphragm sensors are highly maintenance intensive since they tend to get contaminated by H_2S or NH_3 and require a running-in time before stable values are generated.

By comparison, Endress+Hauser's COS61 optical oxygen sensor needs to be accessed for maintenance three or more times less often. Since COS61 is built on the standard 40mm design, it can directly replace the older amperometric diaphragm sensors. Retrofitting costs are therefore minimised and existing transmitters, flow assemblies and immersion tubes may continue to be used.

Contact 1300 363 707, email info@au.endress.com, www.au.endress.com

LEAK DETECTION TECHNOLOGY SAVES WATER AND MONEY

Melbourne is still in drought, even if water storages have reached the 60% level. Back in 2003, Melbourne's reservoir levels dropped to 40.2% and Stage 2 Water Restrictions were introduced. As a result, individuals, business and industry were encouraged to reduce potable water consumption.

In the same year South East Water pioneered the use of a new acoustic leak detection technology, in an attempt to identify hidden leaks in its water supply system. In 2003/04 the introduction of the acoustic technology saved close to 250,000kL of potable water and increased network efficiency.

Identifying leaks quickly and cost-effectively is a key issue in South East Water's commitment to water conservation. Solving the problem of thousands of litres of water literally going down the drain each

year is crucial for the sustainability of the community, the environment and the water industry.

As a result of South East Water's successes with the acoustic leak detection technology, other water utilities and commercial organisations have approached South East Water and their alliance service provider, 'us' (Utility Services) to undertake examinations of their water pipe networks.

Utility Services completed a two-week program of acoustic leak detection services for South West Water (as from 1 July part of Wannon Water), located in Warrnambool, Victoria.

Testing was conducted over 32 kilometres, on a variety of pipe types and pipe diameters. The examinations revealed seven hidden leaks within their water main network, which were not noticeable on the surface.

It was calculated that the total water lost from the seven leaks was around 300 litres per minute, which equated to three per cent of the total annual demand in Warrnambool. Given the annual tariff in Warrnambool is 65 cents per kilolitre, the estimated water lost would have an annual retail value of over $100,000.

South East Water was also approached by one of its major business customers situated in the Melbourne metropolitan area. The customer suspected a leak in the water pipes located on their commercial premises.

'us' - Utility Services deployed two technicians to undertake an examination of their water pipes. Using the acoustic leak detection technology, the technicians located a leak in a pipe under 200mm of concrete and paving materials. The loss rate of the leak was calculated at 10 litres per minute, equating to more than 5,000 kL per annum. The estimated water loss would have an annual retail value of more than $4,000.

One advantage of using the acoustic leak detection technology is that it combines noise logging and leak noise correlation in a single process. This cuts the inevitable delay experienced with conventional methods between the deployment of noise loggers and the arrival of the team to pinpoint the leak.

The process of deploying the acoustic leak detection technology services is extremely quick and non-invasive to the environment. The approach is based on the deployment of highly sensitive and accurate noise loggers called 'pods' which are attached to surface fittings such as fire hydrants and valves. The pods, which are time synchronised, record sound in short bursts lasting a few seconds. The recording is repeated multiple times to separate genuine use from suspected leakage.

The information is then transferred from the pods to a laptop, where the information is cross-correlated. Specialised software uses the cross-correlated information and identifies any leaks, pinpoints them on a pipe layout diagram, tabulates the information and ranks the leaks in order of priority.

The acoustic leak detection technology services are available to government, commercial and industrial businesses, and can be deployed to detect leaks in all water mains and pipes.

Contact Bernd Vetter (03) 9552 3050
Email: bernd.vetter@usus.com.au

REMOTE ENVIRONMENTAL MONITORING

Environmental protection involves the monitoring of aspects including native species water quality, pollutants, water levels, air quality, temperature, humidity and salinity. Advances in technology as well as public demand, have led to the development of economically viable and reliable monitoring technology for environmental protection.

AWMA's JO COM Telemetry Division has progressively applied the RAT (Remote Access Telemetry) system to numerous applications, for environmental monitoring and control, across remote locations. One such application of environmental monitoring required the RAT system in Western Australia for the Westonia Gold Mine, located 3.5 hours east of Perth.

This mine recently collected 1.6GL of water and for works to continue this water needed to be pumped out of the mine from a floating station in the middle of the mine pit. A 1 km pipeline was established to transport the water out of the pit area. A further 1 km of pipeline traversed through environmentally protected bushland to contained evaporation ponds. Water was pumped through the pipelines at a required flow rate of 250 L/sec with a maintenance

flow rate of 60 L/sec once the pit was empty.

JO COM Telemetry was required to constantly monitor the pump and pipeline. It was vital that the RAT system detect any leakage or issues associated with the de-watering process, in order to protect the bushland, home to a rare native plant. Should any irregularity occur, the JO COM RAT would instantly shut down the pump and operating systems and send SMS text messages to operators informing them of the alarm and system status.

In addition to the alarm system, the JO COM RAT provided real-time information on operating parameters including system monitoring, data graphing and historical data. Operators access this information via a dedicated web-page on the Internet.

A vast variety of data can be ascertained from remote monitoring, via the RAT system, as well as providing operational control. The JO COM RAT system provides a viable option for any application.

To explore the possibilities of JO COM Telemetry Solutions contact AWMA on 1800 644 852 or visit www.jocom.com.au

DRY RUN DETECTION IMPROVES PUMP OPERATION

Two new features are now incorporated in the Danfoss VLT® 8000 AQUA Series variable speed drives to improve pump operation significantly and result in improved energy savings as well as pump protection in case of dry run situations.

These features will save users from applying specific dry run detection equipment.

Dry run detection: this new feature will protect the pump in case the well runs dry, by shutting down before damaging the pump. Important features are:

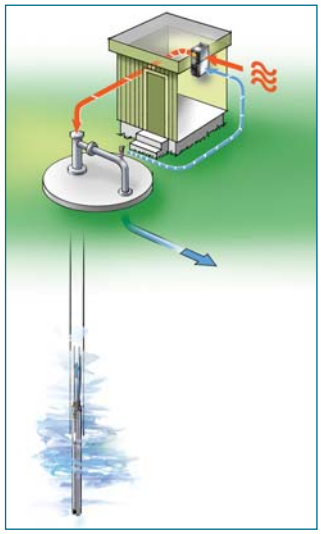
- automatic or manual restart after shut down;
- programmable restart delay up to 1 hour;
- shut down at low or no flow;
- operates in either open or closed loop;
- operates with the Danfoss Cascade controller for multiple pump operation.

Enhanced sleep mode: when using pumps with flat operating curves or when the suction pressure varies, this feature provides excellent control for shutting down the pump at low flow, thus saving energy.

Important features are:

- automatic restart after shut down based on pressure;
- boost function to increase pressure prior to shut down;
- operates in closed loop;
- operates with the Danfoss Cascade controller for multiple pump operation.

Both features are based on drive power and frequency monitoring. Two working points for power and frequency at no or low flow enables the drive to generate the no/low flow power curve. At power values below the curve the drive will be forced to either trip due to dry run or enter sleep mode - depending on the actual drive configuration.



Other dedicated VLT 8000 AQUA features include:

- pipe fill mode to prevent water hammering;
- initial ramp for fast acceleration of submersible pumps to minimum speed;
- motor alternation for duty/stand-by pumping stations;
- Automatic Energy Optimisation (AEO) saves typically 5-10% energy;.
- suitable for constant or variable torque operation.

Contact Ingo Haertel at Danfoss (Australia) Pty Ltd on 0419 911 340 or visit www.danfoss.com.au.

HAESTAD METHODS AND BENTLEY SYSTEMS: ONE YEAR ON

In August 2004, Haestad Methods was acquired by Bentley Systems, Incorporated, a leading provider of software for the design, construction and operation of the world's infrastructure. As part of the acquisition, Bentley promised the development of new solutions and the enhancement of existing Haestad Methods software.

For this one-year anniversary, it is timely to revisit the status of Bentley's Haestad Methods product line. Robert Mankowski, director of product management for Bentley's Haestad Methods Solutions, was asked about the changes which had occurred.

Robert Mankowski

Question: So, it's been a year since Haestad Methods was acquired by Bentley. How has the product line evolved?

Robert Mankowski: Our research and development team has been extremely busy this year, creating new software and developing new versions of existing products. As always, we continue to listen to our users and develop solutions for their needs. The latest releases of WaterCAD and WaterGEMS, for instance, included 74 features initiated by requests from users, along with hundreds of other enhancements. One of the best examples, in my opinion, is the integration of WaterCAD and WaterGEMS with the company's Hammer product for transient analysis - that is making life easier for a lot of water utilities.

Our team has also been focusing on integrating Bentley's Haestad Methods products with MicroStation, the ProjectWise managed environment, and with other Bentley water resources applications, including Bentley Water and Bentley Wastewater. For our users, this means that they can expect to see more options when it comes to integrated modelling and engineering environments. For Bentley, this means that we are continuing with the success that we have shown working within AutoCAD and ArcGIS, confirming our position as the leader when it comes to interoperable hydrologic and hydraulic solutions.

Question: As you said, Bentley's R&D team was busy in 2005 integrating the Bentley Haestad Methods product line with MicroStation and ProjectWise. Were there any new products released?

Mankowski: Yes. Without exception, every application from Bentley's Haestad Methods product line was updated this year with new features and enhancements. Moreover, our new solution for sanitary and combined sewer modelling, SewerGEMS, was released at the beginning of this year. We are particularly proud of this innovative product which offers our users the flexibility to:

Continued over page

Membership Renewals

Corporate and Utility membership renewals are now underway. It is critical that all corporate and utility member organisations take care of this prior to Christmas as only financial members as at 1 January will be eligible for the 2006 *Water Directory*. Listing in the *Water Directory* is one of our prime corporate member benefits and it is paramount that your corporate member contact (as identified in our database) ensure that 2006 dues are paid and that the contact and other details about your company are up to date and accurate by the 16th December. It is from this information that we draw the Directory listings details. The corporate contact can change and update these details at any time using the standard member log-in procedures to access the company record through the AWA web site.

New Members

Since the last issue of *Water* the following new members have joined and we welcome them all into the AWA family.

NEW CORPORATE MEMBERS

NSW

Corporate Silver

Packaged Environmental Solutions
Suite 213A, National Innovation Centre, Australian Technology Park, Eveleigh NSW, 1430
Tel:02-9209-4339

Corporate Bronze

Bega Valley Shire Council
PO Box 492, Bega, NSW, 2550
Tel:02-6499-2259

QLD

Corporate Bronze

Envirocom Australia
PO Box 235, Cleveland, Qld, 4163
Tel:07-3488-9660

Pacific Lining Solutions Pty Ltd
PO Box 25, Grange, QLD, 4051
Tel: 07-3356-6333

VIC

Corporate Gold

Comdain Civil Construction P/L
Po Box 368, Epping, VIC, 3076
Tel:03-9408-7021

Corporate Silver

PPD Airpumps
PO Box 658, Bayswater BC, VIC, 3153
Tel: 03-9761-7747

Corporate Bronze

Hearne Scientific Software
Level 6, 552 Lonsdale St, Melbourne, VIC, 3000
Tel: 03-9761-7747

WA

Platinum Gold

Allight Pty Ltd
12 Hoskins Rd, Lansdale, WA, 6065
Tel: 08-9302-7000

Corporate Silver

Solar Sustain International Pty Ltd
Eagle Jetty 20 Mews Rd, Fremantle, WA, 6160
Tel:08-9335-9921

NEW INDIVIDUAL MEMBERS

NSW
S.Anderson, C.Biggs, M.Dar, B.Flood, Z.Huawg, D.Mullette, F.Smith, J.Wallis,

NT
N.Mules

QLD
J.Ballard, Dr S.Hall, R.Innes, A.Miller, A.Steinfort, D.Stiler

VIC
G.Baud, D.Clarke, M.Giesemann, M.Grozdanoski, W.Rajendram

WA
R.Harvey

Overseas
T.H.Ang, H.Thong, S.Ho, T.Hon, A.M.Maran, M.Mohamed, I.Mohd, T.S.Ng, B.Peck, M.Scheinast, D.Singh, S.Sivapalan, E.K.Soh, B.Tan, S.Venkatajalam, M.Venkatesan, K.M.Yap

Young Water Professionals
T.Purves, D.Waters, J.Verberk, B.Birdseye, C.Centofonti, J.Daniel, A.Degiglio, M.Dixon, P.Dourmouras, B.Eckermann, S.Jansen, M.Johns, S.Keane, Z.Marsden, T.Mckenzie, M.Moffat, D.Mollison, R.Nicdao, D.Partington, S.Price, J.Rasmussen, A.Rouse, S.Semczuk, D.Skabe, N.Slyman, B.Stazic-mandic, H.Benbon, M.Habener, V.Kulkarni, L.Leong, E.Yuen, J.P.Gao, J.Wang, Y.Y.Zheng

CONTACT US

If you think some new activity would enhance the membership package please contact us on our national local call number 1300 361 426 or submit your suggestion via email to membership@awa.asn.au.

Continued from previous page

- Use the platform of their choice. This one product supports four geospatial platforms, namely stand-alone, AutoCAD, ArcGIS and now MicroStation. This platform freedom not only flattens the user's learning curve, but it also improves organisations' productivity by enabling consultants and utilities to work on the same dataset using different platforms.
- Use the dynamic engine of their choice. This product includes both the latest EPA SWMM solver and SewerGEMS' own engine, which uses an implicit solution of the full Saint Venant equations.

Question: What about the commitment to the ArcGIS and AutoCAD platforms? Some users expressed concern that development for these products would stop.

Mankowski: I'm sure our competition would love it if that rumour were true! Actually, the exact opposite is true. In fact, we recently added support for ArcGIS v9.1 and AutoCAD 2006 for our products that run on those platforms, like WaterGEMS, SewerGEMS, CivilStorm, StormCAD, GISConnect, and so on. Support within AutoCAD has been enhanced to include a new elevation extraction feature, and we have tighter integration than ever within ArcGIS, including complete scenario management, FlexTables, custom queries, and so on-you name it, it's in there!

Anyway, it wouldn't make sense to drop these platforms. We have users who depend on these platforms, and it's our job to deliver what our users need. We've never even considered abandoning development and support for the ArcGIS and AutoCAD platforms. We have clearly shown our continued commitment to AutoCAD and ArcGIS users, and we will definitely keep supporting these products-in addition to the MicroStation platform-in 2006 and beyond.

Question: How do you see the future of the water resources modelling software within Bentley?

Mankowski: Technology is advancing rapidly, and our software must adapt just as rapidly to benefit from these improvements - so our job developing Bentley's Haestad Methods product line will never be done. In fact, we are already hard at work on the 2006 releases of our products.

The first scheduled release for 2006 is a new version of WaterGEMS. Expect to see a brand new .NET interface, as well as faster calculations for both small and large models (>100,000 pipes). This version of WaterGEMS will include more than 100 new features in one release!

As part of Bentley, we are able to leverage the work of Bentley's large development group to bring new features to Haestad Methods products.

We will, of course, continue to support the ArcGIS, AutoCAD, and MicroStation platforms. At the same time, software from Bentley's Haestad Methods product line will become more tightly integrated with Bentley's civil and geospatial software to the benefit of all who use those products.

For more information, tel 1800 245 005 www.bentley.com/sewergems/AWA, Email: sales.haestad@bentley.com

For information about the events listed, contact AWA Sydney Office. Tel (02) 9413-1288, Fax: (02) 9413-1047, Email: info@awa.asn.au or visit our website: www.awa.asn.au.

AUSTRALIA

2006

15 February, Sydney, NSW
AWA Sediments Seminar. Venue: Carlton Crest Hotel. Contact: Errin Dryden or Diane Wiesner. Tel: 02 9413 1288. Email: edryden@awa.asn.au.
Web: www.awa.asn.au/events/sediments06

16-17 February, Sydney, NSW
IWA/AWA jointly announces the 1st Young Water Professionals (YWP) Conference. Venue: The Scientia, Uni of NSW, Sydney. Contact: Dr Michael Story or Dr Pierre Le-Clech at email: ywp2006@unsw.edu.au.
Web: www.cwwt.unsw.edu.au/ywp2006.html

23 February, Carlton, VIC
AWA Sediments Seminar. Venue: Rydges Hotel, Carlton. Contact: Errin Dryden or Diane Wiesner. Tel: 02 9413 1288. Email: edryden@awa.asn.au.
Web: www.awa.asn.au/events/sediments06

2-3 March, Sydney, NSW
AWA Master Class Series 2006 - The Pricing of Water. Venue: KPMG, Sydney. Contact: Linda Phillips. Tel: 02 9413 1288. Email: events@awa.asn.au.
Web: www.awa.asn/events

15 March, Adelaide, SA
AWA Sediments Seminar. Venue: Holiday Inn. Contact: Errin Dryden or Diane Wiesner. Tel: 02 9413 1288. Email: edryden@awa.asn.au.
Web: www.awa.asn.au/events/sediments06

20-24 March, Vatious locations, Australia TBA
3rd annual National Golf Day for WaterAid Australia. Contact: Errin Dryden. Tel 02 9413 1288. Email: edryden@awa.asn.au. Web: www.awa.asn.au

4 April, Parramatta, NSW
AWA NSW Branch - Waterscape 2006. Venue: Carlton Hotel, Parramatta. Contact: Contact: Linda Phillips. Tel: 02 9413 1288. Email: events@awa.asn.au.
Web: www.awa.asn/events

18-21 April, Alice Springs, NT
AWA's Water Education Network proudly presents The 2nd National Water Education Conference 'From the Waters Edge to the Red Centre'. Venue: Alice Springs Convention Centre. Contact: Linda Phillips. Tel: 02 9413 1288. Email: educationconf@awa.asn.au Web: www.awa.asn.au/events/educationconf06

8 - 11 May, Melbourne, VIC
Enviro 2006 Conference & Exhibition - Building Sustainable Cities. Venue: Melbourne Exhibition & Convention Centre, VIC. Contact for more information: Quitz Pty Ltd Tel: +61 (0)2 9410 1302. Fax: +61 (0)2 9410 0036. Email: quitz@bigpond.net.au. Web: www.enviroaust.net

OVERSEAS

2006

7-10 March, Merida, Mexico
IWA 7th Conference on Small Water and Wastewater Systems. Contact: Simon Gonzalez. Tel: +52 55 5623 8662. Email: small2006@pumas.iingen.unam.mx. Web: http://pumas.iingen.unam.mx/small2006/

3-7 April, Berlin, Germany
Wasser Berlin 2006 International Trade Fair and Congress - Move with the times. The future is Water. Contact: Ingrid Hagn. Tel: +49 30 3038 2134. Email: wasser@messe-berlin.de. Web: www.wasser-berlin.com

9-11 May, Tel Aviv, Israel
The 16th International Agricultural Exhibition: Agritech 2006 - Growth: Its all in your hands. Contact: Amit Meyraz. Tel: +972 3 5142883. Email: amitm@export.gov.il. Web: www.agritech.org.il.

24-26 May, Singapore
IWA 3rd Young Researchers Conference. Venue: Nanyang Technological University. Contact: Tom Williams IWA. Tel: 44 20 7654 5500. Email: yrc2006@iwahq.org.uk. Web: www.yrc2006.iwa-conferences.org

10-14 September, Beijing, China
IWA World Water Congress and Exhibition. Sustainable Water Management Practices. Venue: Beijing International Congress Centre (BICC). Contact: IWA Conference Secretariat. Tel: +44 20 7654 5500. Email: 2006beijing@iwahq.org.auk. Web: www.iwa2006beijing.com

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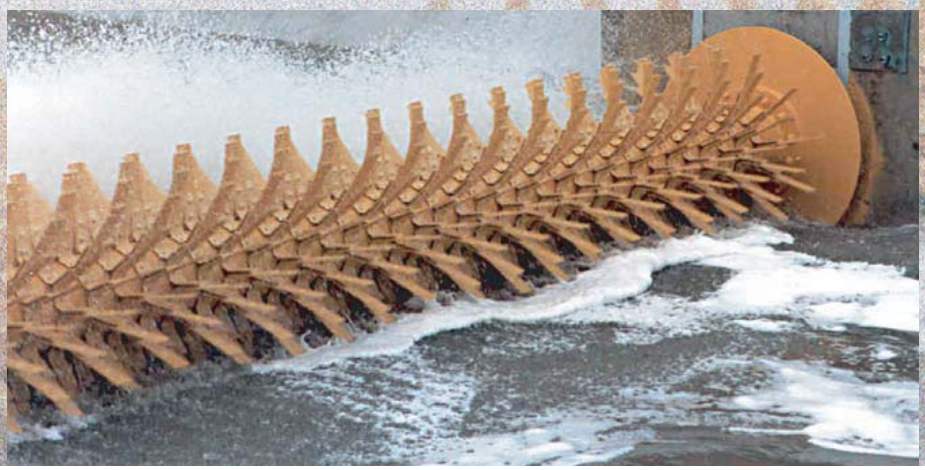

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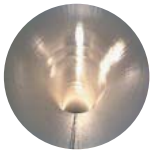

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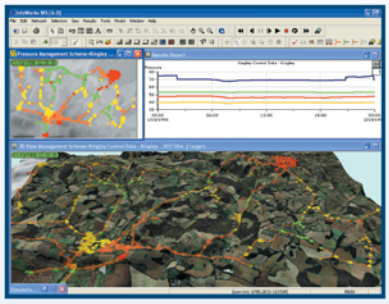

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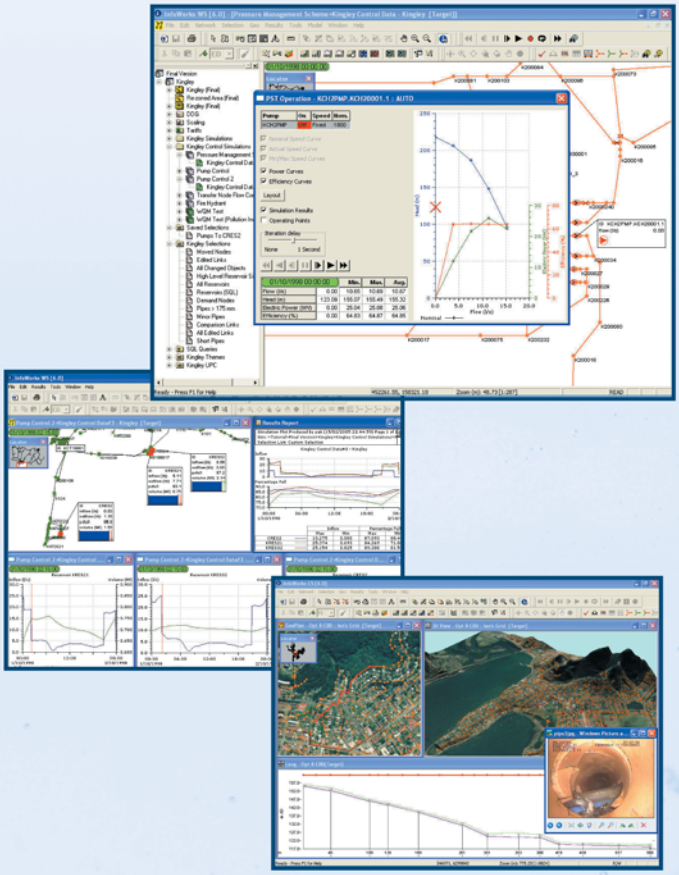

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