WATER WORKS

OFFICIAL JOURNAL OF THE WATER INDUSTRY OPERATORS ASSOCIATION

JUNE 2003

The photograph shows a tanker unloading its "liquid life" to the water stressed township of Broadford in central Victoria. Up to 40 tanker loads a day have been necessary to maintain water to the town over summer. The residents are on the highest level of water restriction.

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WATERWORKS

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Contributions Wanted

WaterWorks welcomes the submission of articles relating to any operations area associated with the water industry. Articles can include brief accounts of one-off experiences or longer articles describing detailed studies or events. These can be e mailed to a member of the editorial committee or mailed to the above address in handwritten, typed or printed form. Longer articles may need to be copied to CD and mailed also.

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The HAZARD of SUMMER

Many Water Authorities in Australia are starting to grapple with the requirements of a Risk Based Water Quality Management Program. With the progressive shift in emphasis away from testing of the final product, to the management of hazards during the passage of water from the catchment to the customer, the concepts of Hazards and Risks are being introduced to many. Some will be familiar with the HACCP approach while others will be drawing more heavily on the Australian Drinking Water Guidelines.

In this edition there are three articles describing the experiences of this past summer. In Eastern Victoria, **East Gippsland Water** grappled with the problem of maintaining supply and quality of water to the small towns of Omeo and Dinner Plain when threatened by the massive alpine fires. In Central Victoria, **Goulburn Valley Water** continues to work to maintain the supply of tankered water to Broadford, a town that has "run out of water" and whose residents are on the highest level of water restrictions. Further north in Victoria, **North East Water** were faced with maintaining production of potable water after a massive downpour of rain, shortly after fire ravaged the catchment, turned the rivers to mud. This required the introduction of high-level water restrictions even though there was abundant water.

One can only be reminded of the poem with that well-known opening line... "I love a sunburnt country..."

All these events have one thing in common. They are typical of summer in Southern Australia. Clearly during such events the huge challenge is to maintain **both** quality and continuity of supply to our customers.

The hazard analysis approach could well be applied to summer. Sure the same critical control points exist but summer puts additional stress on these control points. Perhaps Water Authorities will need to provide an additional focus on these control points when they come under the added and unpredictable stresses imposed by summer.

The experiences in Victoria emphasise the need to anticipate the worst and to develop and practice strategies that will allow us to continue to provide water to customers during these testing times.

So perhaps summer deserves special attention as a hazard for other hazards.

I trust you will find reading about the activities of these Authorities and the dedicated operational staff, inspirational and a true reflection of what operations in the water industry is really like.

Peter Mosse
June 2003

President's Prattle

Nearly half of 2003 has gone already and I can hear people saying "where has it gone"? The WIOA annual general meeting was held recently and a number of changes to the office bearers were made. I would like to thank the previous Executive for their outstanding contribution and congratulate all the newly elected Committee. I look forward to working with them to continue the good work, particularly with the goal of uniting operators Nationally.

The fires in North East Victoria, the ACT and parts of NSW caused major problems for the water industry. Now after some heavy rains, operators in all states are trying to cope with major fluctuations in water quality. The challenges for operators are never ending. The extended drought has also taken its toll with many water storages either dry or at the lowest levels ever recorded. Several articles in this edition of *WaterWorks* outline how operators are keeping the systems running.

Keep your eyes out for the registrations for the Victorian Engineers and Operators conference to be held in Shepparton on the 3rd and 4th of September 2003, and the NSW Operators conference to be held at Penrith Panthers on 16th and 17th of September, 2003. These events are staged to allow water industry staff the opportunity to view the latest advances in equipment, and to hear about issues and their solutions during the technical papers. Your attendance at these conferences is vital for them to survive and for you to develop a network of your peers. Remember you are only one person out of many thousands employed in the industry and your most pressing current problem may have already been solved elsewhere. To quote and old saying, "there's no point constantly reinventing the wheel".

"Happy Operating"

John Harris, WIOA President
June 2003

FIRE AND WATER

Tim East and Robin Burgess

Australia Day 2003 and the days that followed will surely become part of High Country folklore. By noon that day it was nearly pitch black in Omeo's main street.

"It was like a total eclipse but with a big red glow coming up behind it", at least that's how East Gippsland Water (EGW) Operations and Maintenance employee Greg Lee saw it. On the edge of town Terry Watt, another EGW employee observed, "Cow pats in my paddocks were blowing away, and then came the flames, everywhere you looked there were flames leaping and dancing." Greg Lee later added, "I was just wondering on both days at the height of the fires whether we were still going to have a town". During a 24-hour period, including one of the most frightening days in the town's history, 1.2 ML of water passed through Omeo's Water Treatment Plant, double its intended capacity.

East Gippsland Water's Omeo Depot is small. The three EGW staff based at Omeo attend to the water and sewerage systems at Omeo, and Dinner Plain 40 km to the northwest; and the water supply to Swift's Creek, 20km to the south. The total number of sewer connections for both townships serviced by the Depot is around 450, with total water supply assessments for the three towns in the order of 690. Water storage at Swift's Creek totals 4.5 ML, at Omeo around 5 ML with a Water Treatment Plant (WTP) designed to supply a maximum of 0 .5 ML/d, and at Dinner Plain, around 24 hours supply is stored in tanks supplied from bores.

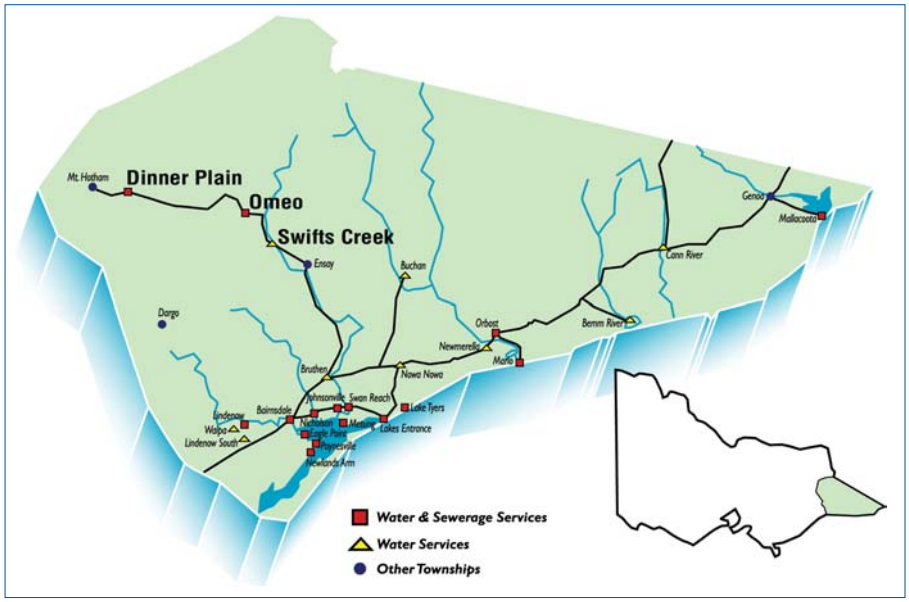
The bushfire situation in the High Country became serious as early as January 8 and, by January 13, the "Razorback" and "Feathertop" fires had been burning for some days. All of EGW's assets in the High Country were at risk. Power outages and problems with water supply and quality were expected.

Monday 13.01.03

The first priority for EGW staff at Omeo was the maintenance of an emergency water supply. Due to high water usage, in excess of 400 kL/d, the Omeo WTP was struggling to keep up. The storage basin was not full and needed topping up. The problem was compounded by damage to a fire hydrant that night but this was quickly repaired.

Tuesday 14.01.03

Voluntary water restrictions and cooler southerly weather reduced water consumption to around 320 kL. The WTP was running at its maximum of around 7.0 L/s, producing 600kL/d, but Butchers Creek (supply source for Omeo storage basin) was almost at a standstill. A draft procedure for the maintenance of an emergency water supply, including the possibility of running water directly from the basin into the town, was prepared but disinfection issues were a considerable concern.



Wednesday 15.01.03

Water usage at Omeo was down to 230 kL and the storage basin was slowly filling.

Thursday 16.01.03

The Omeo Storage Basin was supplemented with water carted from Livingstone Creek. The basin was dosed with hypo at a rate 40L hypo/10kL. A total of 130 kL was added to the basin.

East Gippsland Waters Operations and Maintenance staff, Terry Watt, Greg Lee and Tim East, look out over the burnt out valley towards Omeo.

The Department of Sustainability and Environment (DSE) constructed a fire-break around the bores at Dinner Plain and discussions were held with the Country Fire Authority (CFA) about protection of the bores. A mobile generator was transported from Omeo to Dinner Plain to protect the bore supply system. A water tanker was assigned to the Dinner Plain area and clean up work was undertaken around all EGW's assets.

Friday 17.01.03

The weather forecast predicted a northerly change with strong winds. Emergency preparations continued and at Dinner Plain, which was considered to be more at risk than Omeo, an irrigation system using reclaimed water from the Dinner Plain Sewage Treatment Plant (STP) was set in operation.

Saturday 18.01.03

After all system checks were completed in Omeo, Terry Watt and Greg Lee drove to Dinner Plain to test run the emergency generator set. As it turned out, the generator was down on voltage and the pumps wouldn't run. Another generator was located at Mt Hotham and soon hooked up temporarily. A second generator set had to be sent up from Bairnsdale because the two pumps, which normally ran on mains power, were not linked - and one pump was not going to supply enough water!

Sunday 19.01.03

A southerly wind continued to blow, giving some reprieve, but further weather forecasts weren't at all promising. Omeo staff accompanied the electrician to set up and test both bore pumps and generators at Dinner Plain. Bore 1 had to be hard wired due to a different connection on the outlet but both connections were successful and, once the voltage was ramped up, worked well.

Monday 20.01.03

The weekend passed without incident (fire-wise) and provided an opportunity to further strengthen emergency defences. Again Dinner Plain was the focus of attention and the ground storage and elevated tanks had their floats adjusted to hold the maximum amount of water. The defence system was tested by deliberately overflowing the elevated tank to wet down the tower and its surrounds. The outcome was impressive.

Test results on the effluent from the ponds at the STP showed 0 *E.coli*. The CFA were briefed on the limitations of the water supply system, which could only supply water at 9 L/s. The CFA were shown where they could put a quick-fill pump to take effluent from the sewerage ponds if the need arose and briefed on safety aspects relating to the use of wastewater.

Greg Lee and Terry Watt inspect one of about a dozen water meters "fried" as bushfires entered Omeo gardens.

At Omeo, southerly winds had made the community feel more at ease over the weekend, but smoky conditions had increased water usage up by over 100 kL/d, putting it close to 500 kL, a fair strain on the system. There was no option but to supplement supply with water from the basin to keep up with the demand. EGW's fire-fighting pump was tested and procedures for supplying water to the township were reviewed. The plan was to run water from Butchers Creek through the Omeo WTP until the tank ran out, then to open the emergency basin outlet. It wasn't ideal but it was the only option.

Tuesday 21.01.03

Tim East was interviewed on local radio, reassuring people that there was enough emergency supply while emphasising the need to conserve water, as EGW's ability to harvest water from Butchers Creek was limited to 600 kL per day. The message either did not reach as many as it was hoped, or was to some extent ignored, because usage rose to 454 kL, only 90 kL of which went to sewer.

EGW's 800 litre tanks were prepared as mobile water carriers for the prime purpose of protecting EGW assets, one tank on a trailer and the other on a EGW utility vehicle. A dozer was used to clear a fire-break right around the Omeo WTP plant and the area around the fibreglass break-tank was cleaned up.

Wednesday 22.01.03

Tim, Greg and Terry were briefed on the use of a new generator set for the main sewer pumping station and discussed emergency procedures for prevention of

sewer overflow due to potential power outage. Terry Watt picked up another generator set for the minor pump station at Omeo. Technical staff met with CFA personnel to discuss what EGW could deliver in terms of water volumes, strategic fire-plug locations and the limitations of pressure. They agreed that the CFA would take water preferentially from Livingstone Creek, leaving the main supply as a last resort. This would allow people to defend their own homes with the water EGW could provide. The CFA established filling points in town using bulk water carriers and collar tankers. These were to be deployed in areas EGW had defined as having a possibility of low water pressure.

Thursday 23.01.03

Water usage rose to around the 500kL mark again. A satellite phone was organised in case of communication loss. The sim card from the digital phone had international roaming placed on it, and was then installed into the sat phone. Quick and easy calls were thus possible (at around $4.00 per minute) and charged directly to the mobile phone account.

Friday 24.01.03

Tankers start to take delivery of water. EGW received a request for drinking water from Benambra (not within EGW's normal scope of operations). Many people in Omeo begin to run emergency systems and busloads of personnel arrived resulting in a record water usage of 640 kL. This caused some problems with the operation of the WTP. A mobile pump was transferred from EGW's Lakes Entrance Depot to the Omeo WTP to supplement the water from the Omeo Storage Basin straight into the contact tank. This allowed the level in the contact tank to be maintained while allowing disinfection to be maintained with greater accuracy, resulting in increased pressure to the top end of town and ensuring the provision of good quality water.

Saturday 25.01.03

The pump from Lakes Entrance was tested and worked even better than anticipated, providing some relief in the knowledge that the water usage could be met if necessary. As expected, the pressure on town resources increased as the town's population doubled. The septic tank at the CFA station quickly filled and EGW pumped it out and emptied it to the sewer. By 4pm some embers started to drop on the town and, although they are cold, many people begin to put their fire-plans into action. Some spot fires ignite on private land to the north of town. Water usage for the day tops 600 kL.

Sunday 26.01.03

Water flowed back into the basin at Omeo and filled it up a little overnight. The system is still in good shape although usage remains high. Five tankers of water (150 Kl) were delivered to Benambra to top up tanks. Benambra residents are advised that EGW will supply water for drinking only. They must fill drinking water containers from a water tanker provided in the main street.

At 11am the fire spotted a few kilometres from Omeo and within the next 30 minutes all hell broke loose. The town went pitch dark with smoke covering the sun, the red glow behind the hills to the west and north becoming larger and threatening by the minute. By 1 pm the power was off but it was possible to divert raw water past the plant and directly to the tank. A generator was connected to the hypo pump and disinfection maintained. A clearing southerly change hit around 1.30pm and pushed the main fire-front back on itself. Nevertheless, spot fires continued to burn all over town and at 2.30pm were within 50m of the WTP. EGW staff and CFA dealt with this, but the fire flared up again after 45 minutes and had to be controlled again. All EGW assets were patrolled regularly and the EGW generator was later moved to the supermarket to maintain fridges and freezers containing essential supplies.

When power was restored, testing revealed that a residual of 0.3 mg/L at the plant was maintained. After testing all points of the system including (and especially) the refuge area, all water samples show low but acceptable residuals. Tim East reported to the media liaison unit in Omeo that although residents may experience some colour and taste differences, the water remained safe to drink and was expected to improve within the next 24 hours. A check with Dinner Plain showed no real hassles at this stage.

Monday 27.01.03 - Wednesday 29.01.03

The next three days were spent getting the water back to its usual standard and assessing what EGW got right, and what could be improved. By 2pm Monday the water returned to 4 (colour) and 0.98 (turbidity) from 33 and 2.06 so had improved very quickly. Water usage slowed down and the basin refilled ready for the next onslaught.

Thursday 30.01.03

This could only be described as a really, really bad day! Although EGW staff and locals were as prepared as they could be, the sheer speed and ferocity of the bushfire that came at them on that day was unimaginable. Northerly winds gusted at over 100 kph, there were spot fires from one end of town to another and the main fire front seemed to come simultaneously from three directions. "It was undoubtedly the most frightening thing I have ever seen", said Tim East. "All the problems we thought we might encounter occurred, and all the contingencies we had put in place worked".

There were obvious limitations to the gravity supply system and, at the peak of the fires, pressure was low in some areas. The high-level break tank started to lose ground, with water going out faster than it could fill. This was predictable when the CFA reverted to hydrant use (which they had avoided for as long as possible). All in all, the system coped as well (in fact better) than expected, despite consumption of 1.1 ML for the day, double the design capacity of the system.

The fires also threatened Dinner Plain where EGW's irrigation area sustained substantial damage. EGW staff at Omeo assisted over the phone until they could get through around 7.00pm. Fires also threatened Swifts Creek where Brian White, on his way up from EGW's Lakes Entrance Depot to provide respite, stayed until the immediate danger passed. As fire prevented Omeo personnel from reaching Swifts Creek, they maintained regular phone contact with Brian. Again, disinfection was maintained in all systems throughout the crisis, even though Omeo lost power for the next two days.

More than three weeks after crisis day, plenty of smoke hangs around as fires in the region continue to burn. Nevertheless, Terry, Greg and Tim (pictured with Omeo's Water Storage Basin in the background) are clearly in a more relaxed state of mind.

Friday 31.1.03 - Sunday 2.3.03

Tim East left early for a rostered day off thinking all was well. But a series of problems caused the dry well in the main pump station at Omeo to flood, submerging the pumps. Staff worked all day and into the night, using equipment sent up from Bairnsdale. In summing up Tim East said, "I think the emergency procedures we implemented worked pretty well. We were happy that we had done all we could to prepare. Obviously we learned a lot and our procedures will be incorporated into Emergency Response Plans in the future. I hope that some of our planning strategies can help others yet to experience this type of thing. Knowing where to access satellite phones, generators, and testing our system to limits it has never before been asked to cope with, saw some good come out of this."

The aftermath

Remarkably, the overall damage was relatively minor when it is considered what might have been. Up to six manholes suffered from "bulldozer attack", the irrigation area and 500 metres of fencing at Dinner Plain was damaged; garden beds and sleepers at a sewer pumping station in Omeo were burnt and up to a dozen water meters melted. Reports of service leaks (mainly on the consumers' side of the meter) came in for weeks afterwards. EGW continued to provide drinking water to communities outside its area for several weeks and, until power was safely restored, a generator to the general store to maintain food supplies. EGW grown hay was donated from its Bruce's Track Farm enterprise (near Lakes Entrance). Omeo staff continued to pump overloaded septic systems and to liaise with the CFA in regard to response procedures. Customers with damaged services were assisted and advised on home protection with regards to water use. While the threat of fires in the region persisted for days afterwards, it was very important to ensure residents were confident that they could defend their homes with the water supply system provided by EGW. Remarkably, all of that was done while maintaining a disinfected water supply.

"It seems sometimes we are a bit isolated here (Omeo) but everyone helped out, mostly at short notice, and while nice to know that help was always a phone call away, it would be better if the same could be said about much needed rain," concluded Tim East.

Editors Note

Tim East, Terry Watt and Greg Lee were responsible for maintaining an essential service. All admit that at times they were torn between loyalty to their jobs or personal protection of their families and property.

Terry lost fencing, fodder and more than 30 head of cattle in the conflagration. The fire came close enough to destroy a shed and blister paint under the eaves of Tim East's Omeo home.

The Authors

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WATER ON WHEELS

Neil Healey

The towns of Wallan, Kilmore, Broadford and Wandong/Heathcote Junction in North Central Victoria are currently under stage 10 of a 10 stage water restriction. These towns are normally supplied with water from the usually reliable Sunday Creek Reservoir in the Mount Disappointment catchment situated north of Melbourne.

The Sunday Creek Reservoir has a capacity of 1700 Megalitres. The reservoir is usually topped up each year with a good reliable rainfall. In the middle of the summer season it could be reasonably expected to fall below 50% of capacity, before refilling from the middle of autumn

In the autumn of 2002 the rainfall period didn't occur. By August 2002 the storage was below 30% of capacity with no rain in sight.

Stage 5 of a ten stage water restriction was introduced on the 14th of August. This stage of restriction prohibited the use of sprinklers and only allowed the use of a handheld hose to water trees and shrubs in residential and commercial gardens, along with washing cars by bucket.

By 25th September the rain still hadn't fallen and another stage of restrictions was introduced, Stage 7 closely paralleled the stage 5 restrictions, except the times of day to be able to water with a hose was restricted to the hours of 5:00 PM to 7:00 PM.

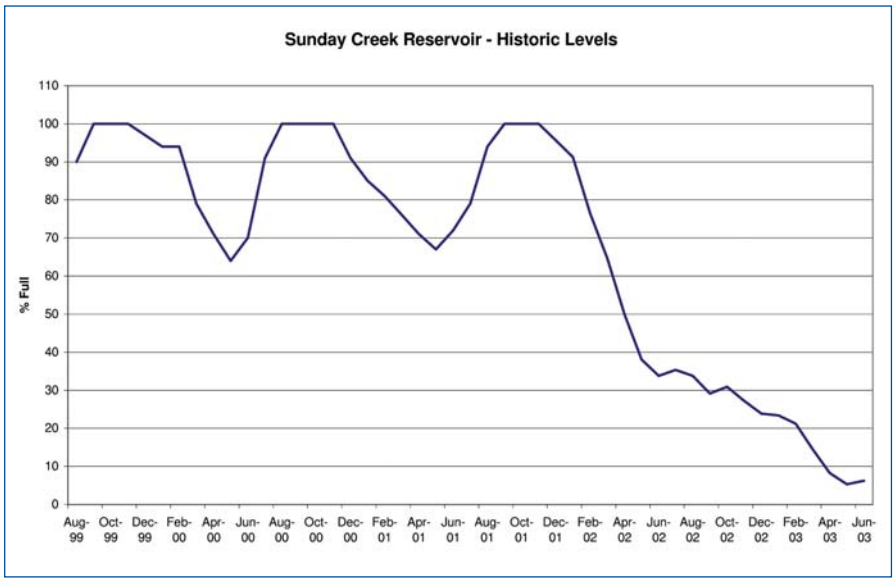

Figure 1. Water Levels in the Sunday Creek Reservoir for the period 1999 to 2003.

With this stage being introduced we also employed some casual people to patrol the area outside of working hours to ensure the restrictions were being complied with.

One month later we decided to introduce another stage of restrictions, along with some other actions contained in our drought management plan. On 1st November 2002 the flow from Sunday Creek Reservoir to the Broadford Water Treatment Plant was restricted to one third of the normal daily consumption. The rest of the townships needs were to be supplemented with the tankering of potable water from Seymour, some 20km away. The idea was to tanker water to Broadford as the preferred option in the plan and to leave Kilmore, Wallan and Wandong/Heathcote Junction to be serviced from Sunday Creek Reservoir.

The water cartage was tendered out and the successful contractor was McColls Transport from Tongala. As a further reflection of the drought, the tankers were usually carting milk from farms in the Goulburn Valley but were sitting idle at this time due to low milk production.

We had to install a 150mm overhead filling point and a flowmeter at the Seymour end and find a suitable route for the 27 kL tankers. At the Broadford end we had to build an access road to the treatment plant site and install some in ground tanks for the tankers to off load. A Flygt 3127 submersible pump was mounted into one of the interconnected tanks to allow for the water to be pumped back up to the elevated storage. The water is rechlorinated during this process.

With Sunday Creek Reservoir now down to 32% capacity along with the water cartage, stage 9 restrictions were introduced on November 1st 2002. The major change from Stage 7 was the introduction of watering trees and shrubs with a bucket only, between the hours of 7:00 and 8:00 AM or 7:00 and 8:00 PM.

Sunday Creek Reservoir, February 2003, at 20% of capacity. The level as at June has reduced to 6% of capacity.

Watering of lawns or grass areas were prohibited at all times.

The cartage of water at that level continued until 27th March 2003. By that time the level in storage at the Sunday Creek reservoir had decreased to less than 10% capacity, and there were no inflows to Sunday Creek at all. We were now experiencing the worst drought in this region in living memory. We invoked stage 10 (the highest level for Goulburn Valley Water) of the water restriction By-Law.

Stage 10 limited water use to the inside of the house only. No water was to be used outside the home. Broadford was now totally reliant on water tankers. We installed a further tank at Broadford to allow for an increase in tanker loads. Flow from Sunday Creek to Broadford ceased and the Water Treatment Plant was turned off.

The tankers now began to cart 1.08 ML per day to Broadford. This equates to 5 trucks carrying 27kL on average, 8 times a day. We have plans to cart water from Melbourne to Wallan if necessary.

Operationally, we have had to be vigilant in saving water at all costs, every leak in the area, no matter how minor

Sunday Creek Reservoir in better times.

receives immediate attention. As a further observation it is clearly more difficult and time consuming to operate a system with little water production than it is when all water storages are full.

Our staff have also been required to monitor water use and deal with the public in relation to enforcement of the restrictions. There have been all sorts of wonderful excuses for using water outside of the restrictions; the standard answer was to claim they weren't aware of the restrictions. Other instances were often nothing more than one neighbour feuding with another. In one case we received a letter from one address claiming the person next door was breaching the restrictions. Upon investigating the claim it was discovered that the person who wrote the letter was in fact the one breaching the restrictions.

Another instance was triggered by a failed marriage and when a complaint was received and attended to, it was discovered that it was just the ex-husband setting up his wife. The response by some people who were caught red handed breaching restrictions was to write a letter to the CEO or the Board Chairman, accusing our staff of harassment.

The impact on staff to respond accordingly to customer needs, to keep the system running and still provide a quality product is a huge challenge, one that they have performed admirably.

At this present stage, Sunday Creek storage is holding 90 Megalitres; this represents approximately 6% of capacity. This event is far from over and rain is not forecast in the area for the immediate future.

The Author

Neil Healey (neilh@gvwater.vic.gov.au) is district manager South West for Goulburn Valley Water.

"I'VE SEEN FIRE. I'VE SEEN RAIN. I'VE SEEN MUDDY WATERS THAT I THOUGHT WOULD NEVER CLEAR AGAIN."

Michael Leak, Roland Passuello, Bruce Tyler

The January 2003 bushfires in the Alpine National Park in the North East of Victoria resulted in two significant challenges for North East Water.

The first challenge was to maintain a potable water supply to the communities that were on high alert during the days that the fire front was on the outskirts of the towns. These communities had seen the devastating results of the Canberra bushfires on residential communities and were consequently preparing for a potentially similar outcome. Water consumption for the towns threatened by the fire front skyrocketed and in some cases outstripped the capacity of the treatment plants, resulting in the need to supplement the supply with raw water and issue boil water notices. Fortunately, the fire front did not pass into these threatened communities, although the stress of being on high alert for two weeks was considerable.

The second challenge for North East Water was, and continues to be, the impact that over a million hectares of burnt catchment has on drinking water quality. Many of the towns in North East Victoria usually receive pristine water from the Alpine areas and consequently the only form of treatment necessary is disinfection. The catchment acts as the treatment plants, so losing the catchment to the ravages of fire has effectively been like destroying our capacity for treatment. The situation was even worse because many of these towns do not have the benefit of large storage reservoirs to draw on when water quality has been affected by rainfall in burnt areas. Rivers run all year round and have been satisfying community needs for decades without the need for supplementary storage reservoirs.

The focus of this paper will be on the impact that rainfall in the bushfire affected catchments has had on river water quality, and the operational challenge to supply clean and safe drinking water to 3 towns in the Ovens Valley - Bright, Porepunkah, and Wangaratta.

Figure 1. The Buckland River still flows a rich brown colour on the 19th May after a weekend of heavy rain. The turbidity here is an order of magnitude less than the staff of North East Water had to cope with in March!!!!

Background

Bright and Porepunkah are tourist towns in the Upper Ovens Valley. The resident population of 2000 and 800 respectively can swell to 4 or 5 times this during the holiday season. Bright draws its water from the Ovens River in the summer months, where it is chlorinated before being pumped into the town reticulation. A 2 ML storage (approximately half the peak day demand) is located above the town, to balance the pumping requirements. Residents in the town have come to expect over the years that the water quality will deteriorate for a short time following heavy rainfall, and seemingly accept this without issue. Porepunkah is supplied from the Buckland River, where water is diverted into a 4.5 ML storage reservoir (1 - 2 weeks supply) and then gravitated into town on demand, receiving a flow-paced dose of chlorine on the way.

Wangaratta is a town of 18,000 people located in the lower Ovens Valley. The water is sourced from the Ovens River just downstream of the confluence with the King River and treated through one of 2 alternative treatment plants located on the one site - a 1950's conventional rectangular upflow clarifier and pressure filter plant capable of 330 L/s or a 1980's conventional direct filtration (DF), dual media plant capable of 350 L/s. The conventional plant is traditionally used all year with the direct filtration plant used during summer months to satisfy increased seasonal demands.

How bad is the river quality going to get?

After the threat of the bushfires had passed, North East Water immediately began to concern itself with how best to prepare for the inevitable consequence of rainfall in these burnt water supply catchments and how to maintain a drinking water supply. We first had to try to predict how bad the water quality was going to get, what were the potential health implications and how long the deterioration in quality was likely to last. On posing these questions to others in the water industry, we pretty quickly began to understand that there is not a great deal

known about the impact of bushfire on drinking water quality. The bushfires presented an opportunity to fill this knowledge gap. A few quick phone calls to the Cooperative Research Centre for Water Quality and Treatment to encourage a workshop to facilitate a research agenda began favourably but unfortunately was postponed until the middle of the year. Human Services were also approached and agreed to support the targeted sampling and analysis of a wide array of water quality parameters with the aim being to understand what the impacts on water quality and human health might be.

So what happened? A day-by-day blow . . .

Wednesday 26 February 2003

Treatment Manager - *Call from CEO 7:30pm. Minister's Department has been on the phone and intends to make sure we have everything in place given the thunderstorm warning issued that afternoon. Quick ring around to all on-call duty officers to remind them of the contingency plans and the requirement to be on high alert. Told not to worry and get some sleep!! Call from Porepunkah Operator 9pm. Has received a turbidity alarm that shut down the Buckland diversion pump into the town storage. Has gone to take a look.*

Bright/Porepunkah Operators - *Can't believe what I am seeing. The rock diversion weir has been wiped out, the river is only just contained within its banks and is a raging torrent, and the water is as thick as a short black and pretty similar in colour. Sample taken for full analysis.* (Flow gauging in Buckland indicated a peak flow of 68 m^3/s at 9:45pm from 0.1 m^3/s only 1 hour earlier – this event tragically took the life of a CFA volunteer who was returning from working on containment lines high in the Buckland catchment. Those that survived described the rainfall as a freakish intense burst of perhaps 100mm in under an hour. The closest rain gauge at Mt Hotham recorded 38mm in 2 hours. Ground survey by Parks Victoria after the event indicated the storm covered an area of 200 ha).

Thursday 27 February 2003

Bright/Porepunkah Operators - *Another trip to the Buckland offtake this morning. River still high but has subsided considerably (1.5 m^3/s). Sample taken last night tested at 129,000 NTU and this morning at 44,000 NTU. Samples diluted 1 in 100!!! Numbers pretty meaningless. Suspended solids tested at 59,000 mg/L and 36,000 mg/L or 5.9% and 3.6% solids - pretty much sludge!! The offtake that services the diversion pump and supply by agreement customer is above the water line now that we've lost the weir. Concerned about getting water to supply by agreement customers. The Ovens River at Bright has seen no impact yet with turbidity 2 NTU. Heavy rain in Bright catchment today though.*

Figure 2. The junction of the King and the Ovens Rivers at the Wangaratta Treatment Plant.

Wangaratta Operators - *Dirty water from the Buckland will eventually get to Wang (Wangaratta) but when? Best guess from our bulk supplier is in 3 days time so we better get ourselves prepared. Arranged samples to be taken upstream to trace when the dirty slug will get to us and commenced a jar testing program to see if we can chemically coagulate this stuff.* ***Bit worried!!***

Treatment Manager - *Got Porepunkah residents immediately on to Stage 4 restrictions. Arranged media to advise customers of the current situation and to request cooperation from the community. Advised that we have about 10 days supply in the town reservoir so we are hoping that river cleans up quickly. Now pretty concerned about Bright's exposure. Still feeling confident that quality will improve by the time it reaches Wangaratta but need to consider actions if untreatable.*

Friday 28 February 2003

Bright/Porepunkah Operators - *Arrangement made for Porepunkah supply by agreement customers to access water from the standpipe in town. The Buckland dropped to 274 NTU, however rain in the Bright catchment yesterday has seen turbidity jump up to 1100 NTU in the Ovens (TSS 700 mg/L). Bright supply isolated from Ovens and now supplemented from the emergency pump on the Bakers Gully storages (these were established during the fires to increase supply capacity and have 15 ML available water at 5 NTU to supply about 10 days restrictable demand).*

Wangaratta Operators - *Jar testing shows that Alum doses up to 350 mg/L do not create a settleable floc. Polyaluminium Chlorohydrate (PACl) appears to be working pretty well but is sensitive to over or under*

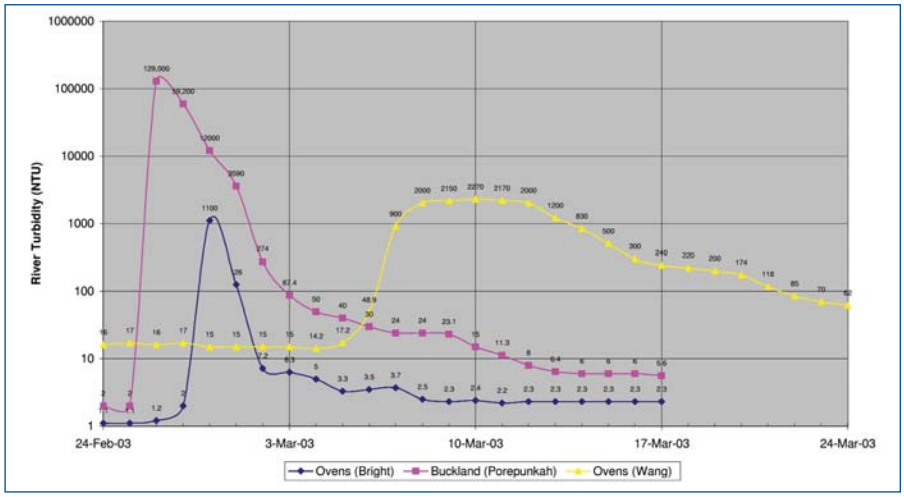

Figure 3. Turbidity data for the Ovens and Buckland Rivers in the aftermath of the heavy rains that fell in the burnt catchments on the 26/2/2003 and 27/2/2003.

dosing which produces a poor floc. Looks like our best bet though. Have placed order for a storage facility and delivery of PACl to be made ASAP. Monitoring of dirty slug has shown it coming!!…

Treatment Manager - *Media to advise Wangaratta residents of dirty slug coming down Ovens River towards Wang and Stage 4 restrictions in Bright.* (NERWA use a four stage system of water restrictions with stage four being the highest).

Monday 3 March 2003

Bright/Porepunkah Operators- *Porepunkah demand has dropped significantly from 600 kL/d to less than 400kL/d due to Stage 4 restrictions. Reservoir at 85%, so still have about 9 days of clean water left in the reservoir. Interestingly the Ovens River(that flows through Porepunkah) has cleaned up pretty quickly. The turbidity peaked at 1100 NTU in the Ovens and is now at 6.3 NTU and improving (Figure 3). Should consider trying to pump this water back through the reticulation up to the reservoir if the Buckland quality is still questionable.*

Wangaratta Operators - *Turbidity peak appears to be falling as the slug passes along the river (Figure 4) however, it's still about 30,000 NTU. Expect river turbidity to be 10,000 by the time it reaches Wangaratta although earlier prediction of 3 days till it gets by Wangaratta seems too fast. Expecting dirty water on 6 March at the moment.*

Treatment Manager - *Concerned about Bright's vulnerability. The emergency pumping arrangement will enable us to provide an alternative source for Bright if the Ovens turns dirty. However, this is only about 10 days worth of supply and we have the Labour Day, Easter and Anzac Day holidays coming up with a large increase in population expected. Commenced enquiries into mobile treatment facilities.*

Wednesday 5 March

Bright/Porepunkah Operators - *In Bright, turned the emergency pump off and now supplying out of Ovens at 3.3 NTU. In Porepunkah, arrangements made to pump Ovens River water back through the retic to fill the basin because the Buckland is not clearing up fast enough (30 NTU). Found a pump and have set it up on the river bank with a flexible suction fixed to a floating pontoon. Rigged up a mobile generator to run the pump and a small hypo dosing pump. Connecting layflat delivery hose into the retic. Currently basin at 35% and likely to be empty by the weekend, which happens to be a long weekend with tourism related increase in demand, so we need to get this going by Friday.*

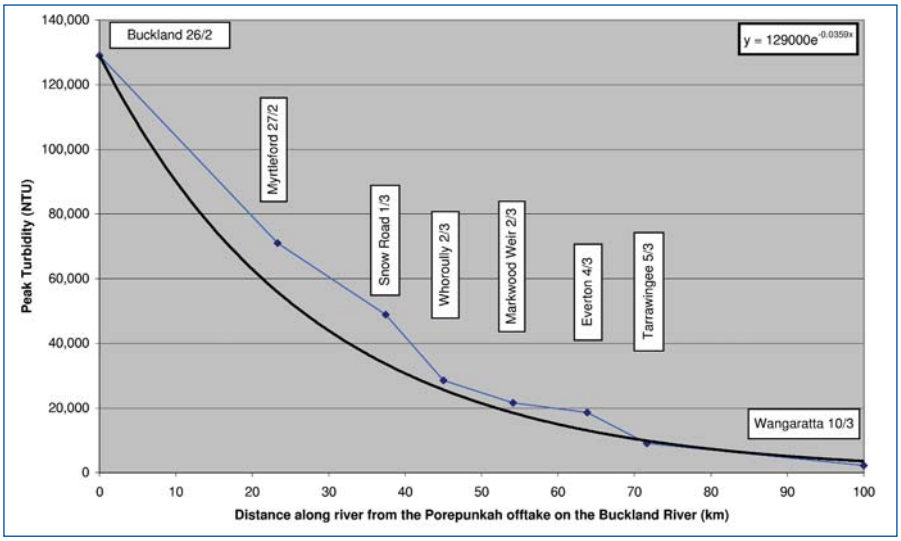

Figure 4. Decrease in peak turbidity as dirty water passed down the Ovens River over the period 26/2/2003 to 11/3/2003.

Wangaratta Operators - *Changed operation of the plant in preparation for the dirty slug now about a day or so away, but turbidity peak still dropping as it gets closer (expecting 5000 NTU) (Figure 3). Treatment process modified to run through sedimentation first then the DF plant filters, rather than the pressure filters. The DF plant has a larger surface area, air scour cycle, and is dual media, which should deal better with higher solids loads and the addition of polymer not normally applied in the pressure filter process. Also changed coagulant today from Alum to PACl and dosing at 8 ppm.*

Thursday 6 March

Treatment Manager -*Treatment process in Wangaratta needs to be slowed down to assist the removal of solids so Stage 4 restrictions were applied today. DHS now concerned about impacts for Wangaratta if the treatment plant is not capable of removing turbidity to less than 5 NTU. Contingency plan to implement boil water advisory measures if necessary. Will put Porepunkah on a boil water notice tomorrow in preparation for pumping from the Ovens due to lack of 30 minute contact time. Local holiday businesses informed of this in preparation for the long weekend. Restrictions lifted in Bright only (resulted in a doubling of demand). Ministerial pressure being applied to guarantee Bright water quality (pun!!) over Easter/Anzac holiday period, escalating the need for supplementary treatment.*

Friday 7 March

Bright/Porepunkah Operators - *Started emergency pump on the Ovens River and all went smoothly. Basin dropped to 25% and would have been empty by Sunday lunchtime. Buckland still taking time to clear - 24 NTU.*

Wangaratta Operators - *Turbidity over 100 NTU in the river at noon yesterday and has been steadily increasing. At 7am it was 450 NTU and at noon it was 900 NTU. Major problems trying to maintain coagulation due to rapid changes in turbidity. Sludge blanket in clarifiers lifted into launder troughs at 12pm and was over 100 NTU - immediately shutdown plant to allow blanket to settle and sludge dumping to occur. But blanket didn't settle. In trouble!! Jar tests undertaken gave confidence that water was treatable and confirmed dose rates were correct. Only option with unformed floc in clarifiers was to dump and start again. At about 5pm the plant was restarted at a lower flowrate (critical) and the unflocced water was pushed up into the launder troughs and wasted through the DF plant backwash troughs. At 5am clarified turbidity dropped to below 10 NTU and we began making water again, delivering at 0.5 NTU. Possible causes of clarifier problems were running the clarifier too hard, non optimal coagulation due to rapid changes in raw water quality, and/or an incompatibility reaction between the existing Alum based sludge with the newly formed PACl based sludge. For the period of 17 hours that we didn't make water, treated storages dropped from 80% to 30%. All hands were on deck to get the process going.*

Treatment Manager - *National and local media frenzy advising of current problems and Stage 4 restriction. Police and Council plan to invoke disaster plan when it was thought Wangaratta might run out of water. Redirected treatment staff to Wangaratta to assist in troubleshooting and getting the process going again. Goulburn Valley Water contacted and provided specialist staff to assist. Carted 0.38 ML water from Benalla in an effort to supplement supply.*

WQ Monitoring Wangaratta	ADWG Guideline H	ADWG Guideline A	Units	27-Feb Ovens River	27-Feb Buckland R.	4-Mar Ovens R. 20km.	6-Mar Ovens River	6-Mar Entry Point	15-Mar Ovens River	15-Mar Top of clarifier.	15-Mar Entry Point
ARSENIC_ICPMS	0.007		mg/L	< 0.001	**0.28**	**0.12**	0.003	< 0.001	0.004	< 0.001	< 0.001
CADMIUM_ICPMS	0.002		mg/L	< 0.0002	**0.0037**	0.0006	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
CHROMIUM_ICPMS	0.05		mg/L	< 0.001	**0.92**	**0.33**	0.007	0.001	0.010	0.003	0.003
COLIFORM (C)	0		orgs/100mL	2400	> 24000	> **240000**	> 2400	0	> 2400	59	
E COLI(C)			orgs/100mL	61	> **24000**	**39000**	**200**	0	**460**	7	
FAECAL STREPTOCOCCI			orgs/100mL	62	**81,000**	**8000**	94	0	~ 170	0	
IRON_ICPMS		0.3	mg/L	0.71	**740**	**330**	**7.1**	< 0.05	**9.6**	< 0.05	< 0.05
LEAD_ICPMS	0.01		mg/L	< 0.001	**0.98**	**0.22**	0.004	< 0.001	0.006	< 0.001	< 0.001
SUS SOLIDS			mg/L		**36000**	**4100**	48				
TOC			mg/L	2	**51**	**26**	3	< 1	**4**	3	3
TOTAL N			mg N/L	0.33	**410**	**48**	0.56	0.10	**0.66**	0.39	0.31
TOTAL_P			mg P/L	0.038	**110**	**18**	0.11	< 0.005	**0.14**	< 0.005	< 0.005
TRUE COLOUR		15	PCU	30	160	140	20	2	83	4	5

Notes
1. 27 Feb result is baseline sample before rain impacts.

Table 1. Monitoring data from the Ovens River over the period of the dirty water event.

Saturday 8 March

Wangaratta Operators - *River turbidity still climbing (Figure 1) and went over 2000 NTU at 5pm. Adding PACl at 45 ppm and Poly at 0.35 mg/L, creating 6.5 NTU clarified and 0.4 NTU filtered. Also adding poly at 0.05 mg/L into DF filters to help control breakthrough. Undertaking half hourly jar tests on actual dosed water passing through plant to get early indication of poor coagulation, rather than wait 4 hours for the impact to be noticeable in the clarifiers (in 2 weeks, 350 of these jar tests were undertaken around the clock).*

Monday 10 March

Wangaratta Operators - *River turbidities peaked at 2,370 NTU. Dosing 55 ppm of PACl and 0.32 mg/L of Poly, creating 11 NTU clarified and 0.4 NTU filtered. Sludge management in clarifiers becoming a challenge. Sludge settleability tests showed the clarifiers are settling 40mL sludge for every litre treated, or 4% of treated water was sludge. This represents about 0.5 ML of sludge that needs to be dumped every day. Pushing the plant harder will mean producing more sludge that*

at some point will become hydraulically impossible to dump. Cones are dumping every 45 minutes automatically as the blanket level is continuously above the cones and manual dump valves are also cracked open to keep sludge blanket beneath launders. The plant doesn't catch up with demand until around 3 - 4am. When the plant stops, the sludge blanket has an opportunity to settle so the first thing the 6am shift does is to dump the blanket for 30min before starting the plant up for the day. This worked well for the entire period and at times only just managed to keep the sludge blanket in the clarifier.

Tuesday 11 March

Wangaratta Operators - *River turbidities around 2000 NTU. Jar testing to optimise dose rates revealed that the addition of soda ash (suggested by Nigel Johnson from GHD's Melbourne office) improved settled water turbidity. Raw water pH increased from 6.5 up to around 7 - 7.5. This resulted in predosing soda ash at 26ppm, PACl at 60 ppm and Poly at 0.4 mg/L. Around 90 separate jar tests or 6/day were conducted to optimise the chemical configuration. Other interesting fact is that we are producing all the water we can at 30% of our current capacity yet the chlorinator is running at 90% capacity. Suggests 3 times normal chlorine demand.*

Friday 14 March

Treatment Manager - *A mobile water treatment plant has been delivered and commissioned in Bright to treat dirty Ovens water ("Actiflo" clarifier plant courtesy of Vivendi Water). Buckland turbidity has dropped to 6.4 NTU so have decided to deliver this water into the basin and lift Porepunkah Stage 4 restrictions. Wangaratta treatment plant flowrate can now be increased by 50% due to reduction in Ovens turbidity to 800 NTU. Decided to lift Stage 4 restrictions to Stage 3.*

Sunday 23 March

Wangaratta Operators - *River turbidities finally dropped below 100 NTU. Town back on Stage 2 restrictions tomorrow. Very suddenly, the chlorine demand dropped back to normal levels again.*

Time to get some sleep before the next rainstorm ruins our social lives again!!

Figure 4 shows the decrease in peak turbidity as the dirty water passed down the Ovens River. Table 1 shows monitoring data for the period covering the major dirty water event. Note the elevated levels of the heavy metals and nutrients.

The Authors

Michael Leak (mleak@nerwa.vic.gov.au) is Treatment Manager with North East Water. **Roland Passuello** (rpassuello@nerwa.vic.gov.au) is the Treatment Plant Operator (Mt Beauty, Bright and Porepunkah) and **Bruce Tyler** (btyler@nerwa.vic.gov.au) is the Treatment Plant Operator (Wangaratta).

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OFF TASTES AND DISTRIBUTION SYSTEMS

Studies Using UV-Vis Spectroscopy

Peter Mosse

The distribution system was long considered a simple system of pipes conveying water from a raw water source or Water Treatment Plant to the customer. It is now recognised as a complex bioreactor that has the potential to adversely affect the quality of water delivered to the customer.

The effect of the distribution system on water quality has been difficult to study. To overcome the shortcomings of conventional methods, new analytical tests and investigative techniques have been developed. UV-Vis Spectroscopy is one method that can be used to study the quality of water as it passes through the system.

A newly released on line instrument the s::can Spectrolyser™ offers a convenient way to make the measurements and handle the data. This report shows how the unit has been used in one distribution system to better understand the transformations that occur in water as it passes through the distribution system and to investigate a taste and odour problem in that system. The studies were conducted in Sale (Victoria, Australia).

The City of Sale has had several periods of very unpleasant tasting water over the last few years. The events are irregular and occur at different points in the distribution system, in some cases in a single house.

The unpleasant taste, although detectable in the treated water, is most noticeable when the water has been boiled and used for hot beverages. The taste can be described as "medicinal" or "phenolic". The taste compounds are only present after chlorination at the WTP and their formation is not related to the use of water in household appliances. Limited studies to date have shown the presence of chloro and bromo substituted phenols in the boiled water.

Figure 1 shows the spectra of two samples of water that produced the characteristic "medicinal" taste after boiling. The effect of boiling is clearly apparent, with the boiled sample having higher absorbances at all wavelengths.

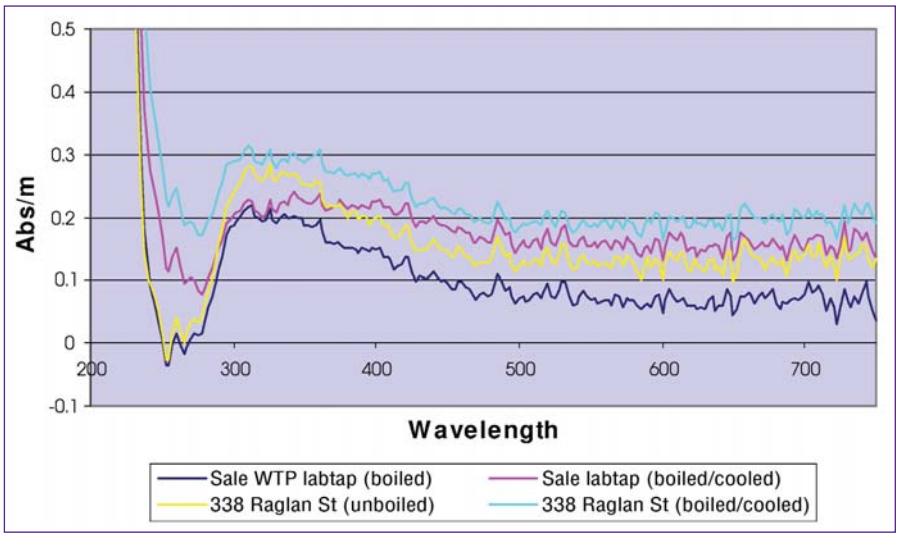


Figure 1. The effect of boiling on the UV-Vis spectra obtained from two water samples.

The possible impact of the distribution system on the generation of the taste was investigated. Figure 2 shows UV-Vis spectra of water obtained from a number of sites within the distribution system. The sites were chosen to reflect a range of residence times within the system and include sites with known taste problems.

In general, the higher the absorbance, the poorer the quality of the water. Although there is a tendency for absorbances to increase the longer the water is in the system, there are notable exceptions. The sample with the longest residence time (Wandana 51 hrs) has an absorbance spectrum more similar to sites with much shorter residence times. Two sites with the same residence time, but which are geographically separate (Lansdowne 16 hrs and Dawson 16 hrs), have significantly different absorbance spectra. Taste complaints have been received from the Dawson site but not the Lansdowne site. Complaints have also been received from the Chalmers (43hrs) site.

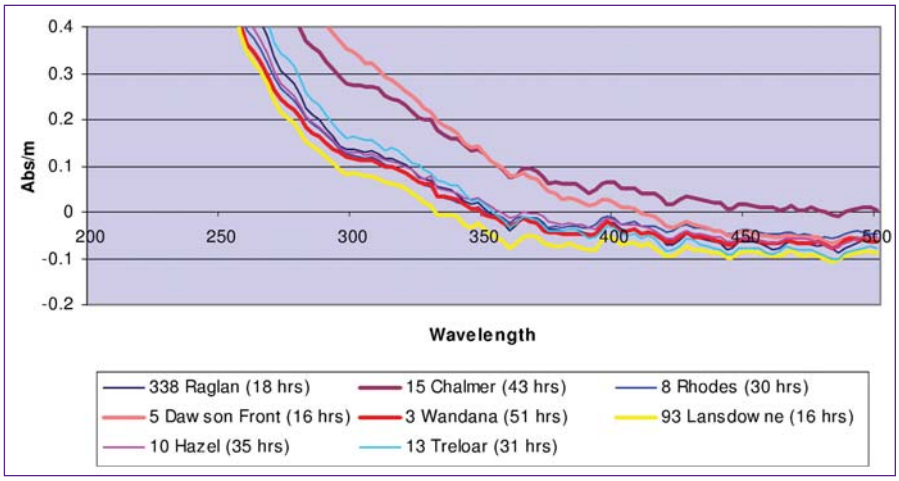


Figure 2. Spectra obtained from sites within the distribution system with different retention times.

Notably the two sites with the highest absorbances are those where complaints have been recorded.

In situations where taste and odour problems have been reported they are often specific to one particular property but not nearby properties. To assess the effect of household plumbing on water quality, samples taken from the tap at the front of the property and from a tap inside the property were compared. Figure 3 shows two such properties. For the Dawson site which had reported problems in the past but which did not have problems at the time of sampling, the two samples are very similar. At the Alexandra site a slight increase in absorbance was evident in water taken from the inside tap. The water from the inside tap had a faint unpleasant medicinal taste that was not detected in the water from the front tap. It should be noted however that the two samples taken from the Alexandra site had lower absorbances than the Dawson site. The implications of this are unclear since in most cases it was the samples with the higher absorbances that were associated with taste problems. As noted above the Dawson site has recorded taste problems several times in the past. This is consistent with the higher absorbances recorded in these samples however on this occasion there appeared to be no taste apparent.

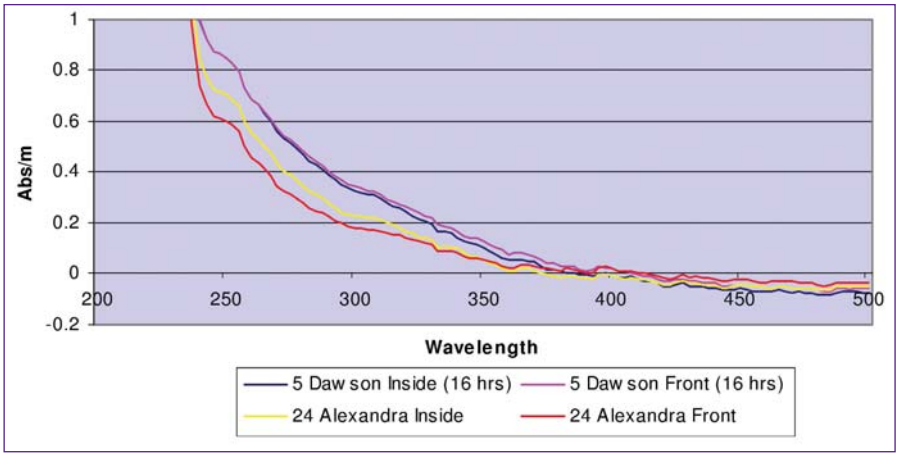


Figure 3. Comparison at two sites of water sampled from the tap at the front of the property and from an inside tap.

Figure 4 shows a more extreme example of this "property" effect where the spectra for samples taken inside and outside the property are significantly different. Note the different scales in Figures 3 and 4. The property in question reportedly had significant corrosion of its galvanised iron piping.

Sale is supplied with raw water from several bores, each accessing the same aquifer. The bores are typically less than 1 km apart. The possibility that the irregular occurrence of the problem might have been related to water from the different bores was investigated.

Quite unexpectedly there were significant differences in the spectra obtained from water from the different bores (Figure 5). Subsequent laboratory trials showed the taste was present regardless of

the bore in use. The taste is not present until after chlorination has occurred.

The extent of the taste was found to be dependent on the free chlorine residual leaving the plant. The plant typically operates with a chlorine residual of between 0.3 mg/L and 0.4mg/L. At a free residual of 0.5 mg/L a large number of complaints were received and the unpleasant taste after boiling was much more apparent. The combination of the initial chlorine dose, the effect of the distribution system and the effect of individual property plumbing seems to account for the sporadic occurrence and distribution of the problem.

Work is under way to find a treatment regime to remove the precursor compounds responsible for the production of the taste compounds. Two trials are being conducted, firstly to replace chlorine disinfection with chloramine disinfection and secondly, treatment of the raw water with Powdered Activated Carbon. The effectiveness of PAC dosing at a bench level has also bee successfully monitored using the Spectrolyser™.

The results show that s::can Spectrolyser can be used to detect differences in water quality occurring throughout a distribution system and to pinpoint problem sites within the system.

The s::can Spectrolyser™ used in these investigations was leased to Gippsland Water by DCM Process Control. The Spectrolyser™ is a compact fully submersible on line UV Vis Spectrophotometer suitable for field laboratory work or on line monitoring. The unit is capable of measuring absorbances at wavelengths from 200nm to 750 nm at 2.5 nm intervals at a sampling interval as short as 2 minutes. The unit can be programmed to provide quanitification of a large range of parameters including in fresh water DOC, Nitrate and A254.

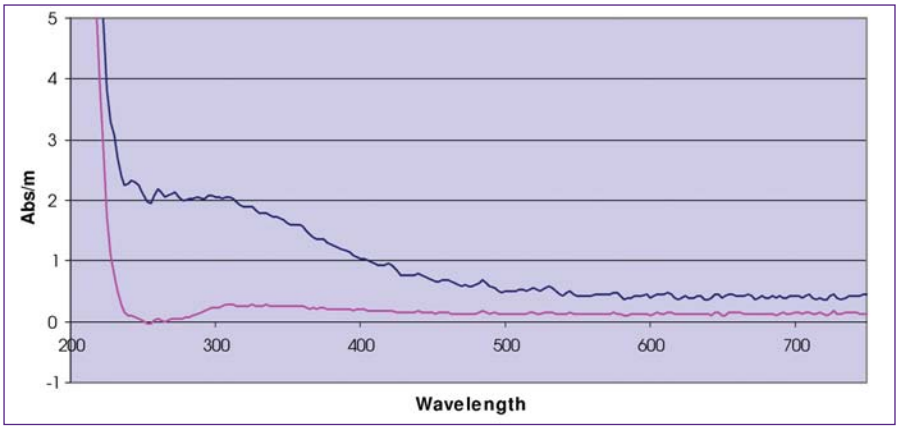


Figure 4. Comparison of samples of water taken from the tap at the front of the property and from a tap inside the property. The property repeatedly experienced poor tasting water.

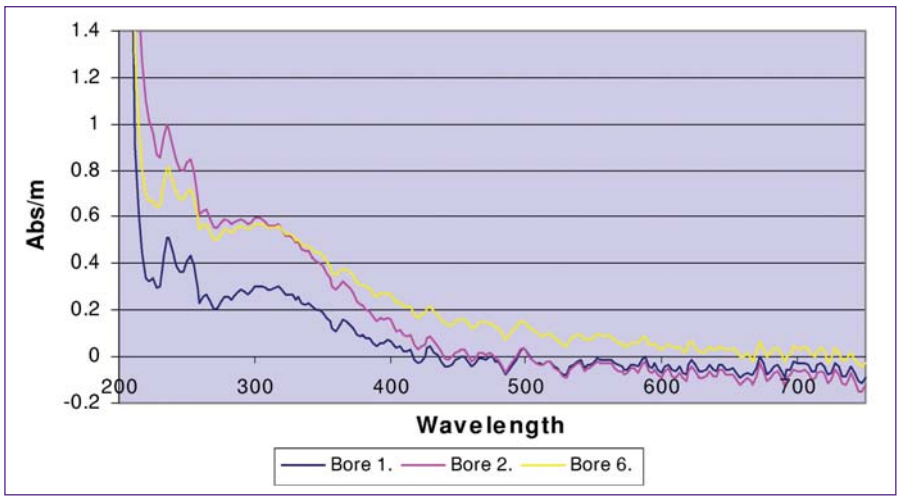


Figure 5. Average UV-Vis spectra obtained for water originating from 3 different bores.

The Author

Peter Mosse (mossep@gippswater.com.au) is currently working as an internal consultant in Water and Wastewater Treatment with Gippsland Water and with other clients.

COVERING OF TREATED WATER STORAGES TO IMPROVE WATER QUALITY TO CUSTOMERS

Len Ablett

Background

The Warragul Water Treatment Plant (WTP) supplies raw water from the Tarago River to the townships of Warragul, Drouin, Nilma, Darnum, Rokeby, Buln Buln and Warragul South, approx 20000 people. The reticulation system to supply these towns is very large.

The Warragul WTP Basin and chlorine contact tank previously had no roof or cover. This allowed a source of contamination for the treated water in storage. For protection of customers the correct disinfection of this treated water was necessary.

Warragul WTP utilises chlorine gas for disinfection. This disinfection is performed in two stages, a primary kill stage where chlorine is dosed into the inflow of the chlorine contact tank, and a secondary residual trim stage where the outflow of the chlorine contact tank is topped up to provide a consistent residual value of chlorine to customers.

To ensure compliance with WHO water quality parameters, higher dose rates, up to 1ppm free chlorine, were used. This meant that customers observed and complained of chlorine taste and odour issues.

Objectives

The covering of the basin and chlorine contact tank, was undertaken for the following reasons:

- to reduce the potential for contamination of the treated water from external conditions (wildlife, dust, etc).
- to reduce the decay of chlorine dosed by eliminating sunlight from the storages.

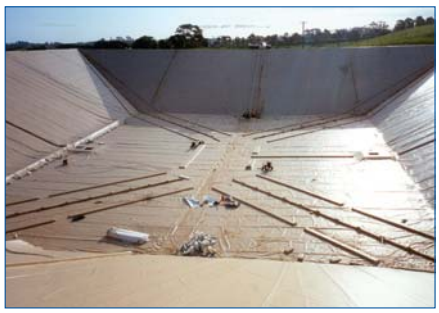
Gippsland Water made a policy a few years ago to progressively enclose all treated

Typical basin visitors in the past

Basin cleaned ready for lining and covering

Basin liner complete, cover underway

Laying cover material



Cover basically complete

Basin full, wind under cover

Chlorine contact tank roof complete

Inside view of chlorine tank

Photograph Competition

WaterWorks requires photographs for its cover. If you have a photo showing an operational activity, why not send it to us. Any photo used on the cover will earn the photographer a free membership to WIOA for one year.

water storage basins. The Warragul WTP storages were one of the earlier storages to be completed. Further basins have been covered since the Warragul WTP storages were completed. The works were undertaken by specialist contractors (approx $200,000 chlorine contact tank roof and $250,000 basin cover) and completed over approx 2 months.

Results

With the work complete the overall chlorine consumption dropped by approx 50%, most of this saving resulted from the 1st stage of the process. The following improvements were observed:

- A saving in the cost of chlorine consumed on-site
- More consistent and lower chlorine residuals (0.5 mg/l) being discharged to the customers via the reticulation pipework
- No *E.Coli* counts observed within the reticulation pipework
- The storage within the chlorine contact tank provides back-up disinfected water during periods of power failure for customers
- Reduced customer complaints, particularly in relation to taste and odour.

Conclusion

The disinfection system is now able to provide a low (approx 0.4 mg/l) and consistent chlorine residual over the entire reticulation system. Monthly water quality sampling has provided no failures with regards to bacteria for the entire reticulation system since the changes were introduced. As Gippsland Water encloses more treated water storages similar results are being observed in other areas.

The Author

Len Ablett (len.ablett@gippswater.com.au) is a Water Treatment Plant Operator at Gippsland Water.

GOOD IDEAS FROM THE COALFACE

NEW!

Stan Stevenson from the Gold Coast wrote: "We recently employed a guy from a country authority who had a different approach to cleaning lime dosing lines than we did. We have since adopted his methods and this has resulted in time savings as well as removed the need for a less than pleasant task for Operators.

We are now using a weak strength chlorine solution to clean our lines rather than physically removing lines and bashing them with a blunt implement to remove scale from the lining."

Stan can be contacted at SSTEVENSON@goldcoast.qld.gov.au

Editors Note

Over the years Operations staff have come up with many good ideas to make life easier or to save money. Want to share your ideas with others?? Why not forward your labour saving ideas to us for inclusion in this section.

DO YOU KNOW YOUR D.O.

Rob Dexter

Oxygen is essential for the aerobic treatment of municipal and industrial wastewaters. Carefully controlled and varying levels of Dissolved Oxygen (DO) are necessary to create the ideal instantaneous conditions for the removal of Chemical Oxygen Demand (COD), Nitrogen (N) and Phosphorus (P).

Since aeration represents one of the single biggest operational costs in the operation of a Waste Water Treatment Plant (WWTP), accurate control of aeration is essential. Accurate control requires an excellent DO sensing system.

A DO sensor that reads low is likely to cause over aeration of the wastewater. This results in increased power and maintenance costs, and the likelihood of higher than necessary nitrate and probably total nitrogen levels in the final treated effluent.

A DO sensor that reads high gives a false sense of security in that it appears the DO set point has been reached when in fact it has not. Under these conditions both N and P removal are reduced, resulting in an effluent high in ammonia and phosphorous. The resultant low oxygen levels can lead to the growth of nuisance filamentous biomass and a poor settling sludge.

In both situations the plant is likely to fail the discharge requirements for the site during high loading periods.

There are 2 types of DO sensor currently available for measuring DO in wastewater. Both are very good at measuring DO as long as appropriate maintenance and operating conditions are maintained.

With **Membrane Sensors**, oxygen in the wastewater passes through a membrane at a rate dependent on the difference in the DO across the membrane, the membrane permeability and the permeability of any coating on the membrane surface. The oxygen that diffuses through the membrane interacts with the metal electrodes through oxidation/reduction reactions and generates a current flow proportional to the oxygen concentration.

The major role of the membrane is to keep the electrodes clean by keeping them out of the wastewater. The system works well as long as there is nothing to impede the transfer of oxygen across the membrane. Attached fats slow the transfer of oxygen through the membrane and produce a sluggish response of the sensor in addition to providing a surface for biomass growth. A variety of membrane materials have been trialled to prevent biomass and fats attaching to the membrane, HOWEVER all eventually foul to some degree.

Biomass attached to a membrane will absorb oxygen as it permeates the membrane, thereby reducing the amount of oxygen passing through. The result will be under reading of the DO and consequently significantly higher power costs through over aeration.

Figure 1 shows the effect of biomass growth on a DO probe membrane on the

volume of air required to maintain a DO set point. The figure clearly shows the difference in m^3 of air required to maintain the set point before and after cleaning. The size of this difference is proportional to the time since the membrane was last cleaned.

A Treatment Plant operator is unlikely to notice that the blower power is reduced immediately after the membrane DO sensors have been cleaned, since most plant SCADA systems do not display the instantaneous volume of air used, or the total mass of oxygen used per day. Similarly, the increasing power usage as sensors become dirty may not be noticed unless comparisons are available with the same day of the week from previous weeks or some other reference such as an inlet load (BOD) measurement.

The effect of membrane fouling on DO measurement can be readily demonstrated at any treatment plant using a simple test:

- Wait a week or more since the last membrane clean.
- Take a bucket of raw wastewater from the plant inlet prior to introduction of biomass.
- Introduce the membrane sensor *without wiping it* and aerate the waste for 20 minutes using an aquarium pump system with an air stone. Note that the air bubble stream should not be directly impacting the membrane.
- Record the DO reading.
- Now simply *wipe* the probe as normal and reintroduce it to the aerated bucket of wastewater. Wait a few minutes for the reading to stabilise.
- Record the DO reading.
- Take note of the difference in value.

If there is a significant difference between the readings with the second reading being higher than the first, then there must have been something on the membrane that consumed oxygen or otherwise limited oxygen passage through it. In general the size of this difference is proportional to the time since the membrane was last cleaned and to the age and condition of the membrane.

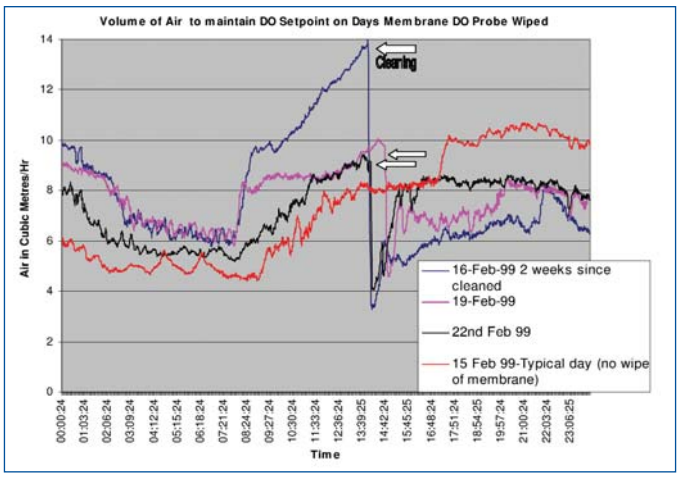


Figure 1. The volume of air required by a pilot plant to maintain a DO setpoint. The plant was treating waste water from the inlet of a major Australian WWTP with aeration controlled by a membrane probe. The figure shows DO trends on three separate days when the membrane sensor was removed, wiped clean with a soft damp cloth and returned to the wastewater. The time between wipes varied from 3 days (mauve and black) to 2 weeks (blue). Note the sudden reduction in the volume of air required after cleaning the membrane. The 4th trend (red) shows a day when the membrane was not wiped.

With **Non-membrane Probes**, two different metal electrodes are immersed directly into the wastewater. The voltage produced by the dissimilar metals in the presence of oxygen causes a current to flow as the anode is oxidized (rusts). The magnitude of the current flow is proportional to the oxygen concentration. The electrodes are kept free of oxidation and other contaminants by a continuously rotating diamond grindstone.

The **advantage** of such probes is that the sensor surface is continually kept clean by the rotating grind stone and the problems introduced by fouling of a membrane probe simply do not occur. Therefore over aeration does not occur, power consumption and cost is minimised, and COD is retained for further nutrient removal. The sensor is very robust and generally only requires a visual check or minor maintenance every 1 to 3 months.

The cost of the non-membrane sensor is more than that of the membrane sensor. However any evaluation of which sensor to purchase should include an evaluation of maintenance costs and the increased aeration costs likely to occur due to fouling of a membrane system. This is typically 10% to 35% of your aeration cost.

The real cost of inaccurate and varying DO measurement includes:

- **wasted aeration power**
- **reduced nutrient removal efficiency**
- **poor effluent quality**
- **possible excessive chemical use for pH control and P removal and**
- **poor sludge quality**

The Author

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BIOSOLIDS RESEARCH UPDATE

Terry Anderson

It's an unfortunate fact of life that every sewage treatment plant produces sludge. Managing to treat sewage is the easy bit, but managing this sludge - well that's the hard bit.

The results of a co-operative venture by the Victorian Government, EPA and the Victorian Water Industry Association (ie VicWater) about how well we are managing sludge today are summarised in a report entitled *"Moving Towards Sustainable Biosolids Management"*. This report concludes that Victoria's sewage treatment plants produce about 70,000 dry tonnes of sludge every year and the current stockpile of this material is about 2 million dry tonnes. It's hard to avoid the conclusion that something needs to be done!

So what are we going to do about it?

One response to this situation has been an increased interest in using the beneficial nutrients and carbon in sludge by applying it to land as Biosolids. (Biosolids is a word used to describe sludge which has been

treated to the point where it can be safely applied to land). This increased interest has resulted in the EPA publishing the draft *"Guideline for Environmental Management". "Sustainable Reuse of Biosolids - Land Application"*. EPA has also requested that every treatment plant submit a plan for sustainable management of Biosolids by 25 July 2003 for approval.

So it is likely that the water industry will be applying Biosolids to land in one form or another in the near future. After all, there's only two other places that sludge can go - into water or into the atmosphere. It is clear that into water (ie the ocean) is not a real option and few water authorities will be able to arrange to put it into the atmosphere by burning it, even with energy recovery.

A key issue is to understand the risks associated with applying Biosolids to land, particularly other people's land.

This means the water industry will need to understand what has to be done to stop people or animals getting sick and to prevent contamination of land or groundwater with chemicals. That's what the **National Biosolids Research Program** is all about. The Program is co-ordinated by Daryl Stevens, CSIRO Land and Water in Adelaide. Work to date has focussed primarily on understanding the behaviour of heavy metals (eg copper, zinc, cadmium) and nutrients under Australian soil conditions.

The Program operates by conducting trials on a range of soil types. Test sites have been established in Western Australia, South Australia, Queensland and New South Wales. There are also a number of similar sites established in Thailand and Vietnam.

The Board of VicWater recently agreed to participate in the National Program following a commitment from most of the members to contribute funds over a four year period. The Victorian Program involves establishment of a number of test sites throughout the State and is co-ordinated by Jo Stokes of the Department of Primary Industries, Werribee. Proposed test sites are located at a number of locations including Dookie, Melton, Pakenham, Dutson Downs and Mildura. Preparation of the trial plots has commenced at several of these sites and will continue throughout the remainder of 2003.

The National Biosolids Research Program will continue over a number of years and a final outcome is not expected until 2007. Progress reports will be prepared annually and reported to participating organisations such as VicWater.

In the meantime, a one day Workshop will take place in Brisbane in July 2003 to identify further Biosolids research needs for possible inclusion in the Program.

Enquiries regarding the Workshop should be directed to Terry Anderson, Telephone: 03 9552 3735, Facsimile: 03 9552 3771, email: terry.anderson@sewl.com.au

A Field Day is also being held at the Dookie site in Victoria on 8 September 2003. **Enquiries regarding the Field Day should be directed to Aldo Penbrook,** Telephone: 03 5833 9287, Facsimile: 03 5833 9201, email: aldopens@unimelb.edu.au

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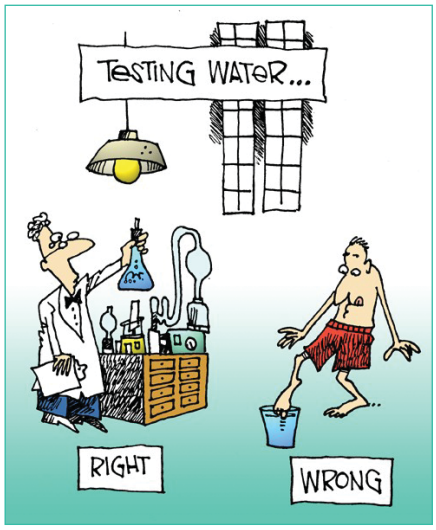
OPERATOR TRAINING REVISITED: YOUR THOUGHTS PLEASE

Welcome to acronym city - I'm about to throw some training news at you!

Having a well trained and competent workforce should be an integral part of any organisations business plan. When the business is responsible for a function as important as the provision of water and wastewater services, workforce competency training becomes essential. With any training package, it is vital that the industry itself is comfortable that options are available to ensure the training needs of all staff are adequately catered for.



Following the release of the National Water Industry Training Package (NWP 01) in 2002, training options available to water industry employees took a major leap forward.

Australian Local Government Training (ALGT), the National Industry Training Advisory Board (ITAB) for Local Government and the Water Industry is responsible for the maintenance and administration of the package following its release. ALGT has been commissioned by the Australian National Training Authority (ANTA) to review the Water Industry Training Package.

To oversee the review process, ALGT has established a National Steering Committee consisting of national representation of water industry people along with key employer and industry groups.

The review will involve two phases. Phase one will involve a review of the package including looking at the content to make sure it is appropriate to industry needs, identification of any barriers to the adoption of the package, determining if the support materials are adequate and in line with quality criteria. A report must be produced outlining the findings. This phase of the review must be completed by September 2003.

Depending on the recommendations made in the first phase report, the second phase will follow on and it is anticipated that it will look at potential improvements to the package, the development of any new units of competency, and reindorsement of the revised package. Any changes are not likely to take effect until at least 2005.

It is not anticipated that significant changes to the structure of the package will be made and importantly, this review should not be used as a reason not to undertake training from the package.

In order to collect the thoughts of the water industry, a series of workshops will be held in each state. This is a great opportunity for us, as the users of the package and the people who will benefit from the training, to comment on issues affecting us.

The type of questions you need to ask yourself include:

- do the units of competency reflect what you do at work?
- are there enough units available?
- are there any units not included in the package that you think should be?
- are the number of competencies contained within each unit appropriate and should there be more or less?
- are the rules relating to the number of units required to complete a Certificate 2 or 3 appropriate?

We recommend that you make a contribution to this process as the wider the range of thoughts considered, the better the overall package will be. Make sure you keep your eye out for the dates and venues of the various State workshops and make sure you attend and contribute if you get the opportunity. Further information on the review can be obtained from ALGT website at www.algt.com.au or by e-mail to the Project Officer at ALGT, Joan Whelan at joan@algt.com.au

The Author

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