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OFFICIAL JOURNAL OF THE WATER INDUSTRY OPERATORS ASSOCIATION OF AUSTRALIA

NOVEMBER 2017

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WATERWORKS
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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. Submissions may be emailed to peter.mosse@gmail.com or info@wioa.org.au

CONTENTS

KEEP IT SIMPLE. PLEASE

Peter Mosse

MicroDALY (µDALY). As they say on social media, this term is going viral across the water industry.

It is being widely used by regulators and many water quality professionals, and it has become yet another buzz word in an industry that seems to be full of buzz words, like "innovation" or "quality systems". But, one really has to wonder how many of those that use the term microDALY really understand it, and could explain what it means to an operator. And then, beyond that, what is the relationship between the microDALY and treatment performance targets at Water Treatment Plants (WTPs), and the operation and risks associated with distribution systems? Unfortunately, probably not that many people could provide an answer in plain English.

As someone who works widely with operators, both in the field and in training, quantitative units often create problems. Milligrams per litre can also be called parts per million or ppm. Parts per billion is also ppb or micrograms per litre. Many operators, and even some water quality professionals, struggle with using the right term all the time. And then there are Ct values and LRVs (Log Removal Values), and any number of other abbreviations and bits of jargon that can just lead to confusion. QMRA (Quantitative Microbial Risk Assessment) is another one of these terms that is beginning to creep into general discussion. Why is QMRA preferable to catchment microbial risk assessment, which everyone can generally understand? The related term, "Health-Based Targets", or HBTs, is only marginally better.

Some operators, with a lot of time and effort, get to understand what this all means, but many struggle and don't really get it, and who can blame them. If those above them often struggle to also understand the jargon? Most operators conceptually understand percentage removal much more easily than LRVs, and that is confirmed by the increasing use of percentage removal figures for "germs" quoted on household cleaning products (e.g. 99.9% of germs killed) for the general public.

So, back to microDALY. Firstly "micro", many struggle to understand what this little prefix means. Throw in the Greek symbol "µ" and it gets worse (the answer is that "micro" or "µ" means one-millionth of something).

Then there is the "DALY" part. What does this mean? How can operators relate to it? They can intuitively understand physical units, such as metres and grams. Therefore, micrograms (one-millionth of a gram) make sense, and kilograms (one thousand grams), similarly. But a DALY – which stands for a Disability Adjusted Life Year. What the heck? Talk about one-millionth of a DALY; and you have lost most operators. At least a micron (one micrometre) can be related to the diameter of a human hair, but a DALY?

I understand well the basis of the application of the risk assessment approach and why the DALY was introduced by the World Health Organisation in their quest to improve global health and identify where best to spend the limited money they have available. I admit that I struggle to understand the derivation of the turbidity and other WTP performance targets that come from using the microDALY as a starting point.

What about the microDALY and distribution system operation? How will field operators relate this to their jobs?

Why alienate the operators? Let's talk in terms they, and we, can understand. Turbidity in NTU, and chlorine residuals in mg/L.

OUR COVER

Water Treatment Operators Dale Hogan and Sam Robertson from Goulburn Valley Water prepare to open up the pressure filter at the Nathalia Water Treatment Plant.

By all means, keep the academics happy in our formal high level documents, but let's not forget that when it comes down to providing safe drinking water, it is the operators who are at their plants, or the multiskilled operators who are in the field, fixing distribution system problems.

Then think of the Project and Capital Works Teams, and the consultants who are asked by their clients to deliver plant performance that meets 1 microDALY in existing or new WTPs. What does it mean to them? Sooner or later, it must be specified in measurable terms as a performance measurement and part of contract delivery. The DALY is not easily measureable.

We at WIOA know the term microDALY will not disappear, and for that reason we plan to try and demystify it in the May 2018 edition of *WaterWorks*. Regardless of that, we have a responsibility to bring operators with us, not alienate them.

Let's keep it simple and de-emphasise the microDALY and talk in every day terms and units that operators can understand. We really cannot talk about a WTP achieving 1 micro DALY (1 µDALY). Let's use numbers that we can all relate to in our everyday work, backed up by a simple understanding of why those numbers are important to the protection of public health.

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Bill Day is the Managing Director of Microfloc Pty Ltd, and a past Principal of *Aquagenics Pty Ltd*

Microfloc's Managing Director, Bill Day sums up the company's ethos as *being able to optimise the integration of value engineering, process and technical excellence with its products and services and to provide ongoing support for Microfloc and Aquagenics' installations.*

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4G Platypus Jar Tester with DAF Test Accessories

CURLEWIS CHLORINATION UPGRADE

Winner of the Iwaki and Nalco Awards for the Best Paper presented at the 2017 WIOA NSW Operations Conference

Brock Stone

Background

Curlewis lies on the Kamilaroi Highway, 17 kilometres South of Gunnedah and 63 kilometres west of Tamworth. Water for the village is pumped from the Liverpool Plains Bore field located approximately 5 kilometres from the town. If you were to ask anyone in Curlewis how their water tastes, the standard reply would most likely be "Don't know, don't drink it". The hardness is some two and a half times the ADWG value of 200 mg/L, high in sodium and chloride and in the range specified by the World Health Organisation as "unpalatable". Drinking water mostly comes from private rain water storage tanks. This inherently creates health risks through lack of maintenance of rainwater collection systems, water age issues and lack of disinfection in the tank supply.

There is a future proposal for a water pipeline from Gunnedah to alleviate some of these issues, however in the meantime, the bore water supply is to be maintained.

The problem was the state of disrepair of the chlorine dosing site and the building. The building was established in 1970, made of brick and mortar with a tin roof (Figure 1). It was a sturdy construction at the time and it kept the weather out. With the introduction of disinfection in 2004, extra funds were not available to support an upgrade to the asset and so year after year, the project was put on the back burner as other concerns were dealt with.

Gunnedah Shire Council employed one Water Quality Officer at this point in time, Greg Ellis, affectionately known as "Slim". He had to cover 16 bore sites, 6 dose sites, 12 reservoirs, 31 telemetry sites over 4 townships spanning a distance of some 250 kilometres. Effective time management was a fantasy, and as it was, a lot of jobs were put aside as priority was given to break downs, sampling and chlorine monitoring.

Awakening

In 2014, I was a Water Meter Reader, but also being trained in Water Quality so I would be ready to perform relief duties for Slim as they arose. I was first made aware of the issues at Curlewis during a training day about the Water Quality role and with the new Safe Drinking Water Guidelines that Gunnedah Shire Council (GSC) had adopted. Both Slim and I were fast learning that this thing called "Water Quality" was going to eclipse all previous understanding of our roles within Council.

During a site visit to the disinfection site during the training, a number of issues were identified.

- Corrosion to the block work and slab
- Rusting supports to the bore perch
- Leaks to the bunding under the hypo tank
- Aging dose pumps and lines with rusted and corroded support brackets
- General housekeeping and maintenance.

August 2015 was a tough month. Slim passed away in a tragic car accident while coming back from Mullaley after completing sampling that morning. He was out doing some field work and never made it home. I was now thrust into a position I didn't expect to be in. The next few months would prove to be one of those "sink or swim" scenarios as one thing after another would either break down, stop working or just get struck by lightning as I was adjusting to this new role without my mentor.

Figure 1. The Curlewis Pump Station and dosing site as it was in 2014.

My respect for Slim only grew during this time considering what he was able to accomplish day in and day out.

Lightning Strikes

In the summer of 2015, when Curlewis Pump Station suffered one of those lightning strikes which fried one of the bore pump cables, one of the dose pumps, different boards in the telemetry cabinet and the electrical switchboard. We were promptly motivated to act on some of the improvement items that had been identified during the training.

After much discussion and number crunching concerning the replacement of lightning affected components, it was decided that we would attempt a complete upgrade during this process with the exception of the previously reconditioned bore pumps.

The proposed new plant would get the full treatment up to $85,000.

The upgrade would include:

- Dose plant
- Two new dose pumps
- Hypo storage tank
- Two new mag flow meters
- New electrical switch board and cabinet
- Security fencing around the site.

In addition to this, consideration had to be made for the plant to be easily relocatable to accommodate the future plans.

We looked into various solutions for the "easily relocatable" aspect of the work and realised pretty quickly that a pre-fabricated module designed for dosing was well out of our price range due to the strict budget constraints. Finally after researching and brainstorming ideas, we decided a cool room was our best option.

Not Quite a Cool Room

Gunnedah is a small community and we like to buy locally when we're able. Council approached local business owners and discussed the idea of a small plant for our dose pumps with them. A design was progressively developed for what would become our own version of a pre-fab Dose Plant. The unit size is 2.4 m x 2.4 m with a solid skid base that can be lifted by crane or forklift. Using the lightweight cool room materials, the internal walls and ceiling are poly vinyl lined and the floor has 2 pack resin coating so that none of the alloy panels could be affected by the Hypo. Ventilation windows were cut into all sides of the room and designed to keep out weather, vermin and insects and an inclined corrugated roof finished off the design. The construction of the building cost just under $20,000 (Table 1).

Demolition

Description	Cost
Pre-fab building on skid	$ 19,922.73
New Dosing Pumps & installation	$ 24,244.00
Electrical & Switchboard upgrade	$ 13,809.09
Fence	$ 8,337.91
Demolition, Labour & plant hire	$ 12,662.38
Total build cost	$78,976.11

Table 1. Breakdown costs of the Curlewis dose plant project.

The demolition of the old building was challenging for the fact that we still had to provide disinfected water to the reservoir during the process.

Local contractors lifted the roof and once removed, started knocking down the walls one block at a time being careful of the dose pumps and lines, control boxes, bore and pipes all housed and attached to the walls inside the structure.

During this process our electrician was starting to set up temporary power to a timber framed stand to support the dose pumps and control cabinet that were previously mounted to the block walls. We then wrapped it in plastic to keep the elements out of the electrical components as it would spend the next few weeks with only that for protection during the build. It wasn't pretty but it worked.

Completed Works

Once all the components were delivered to the site, the build came together quickly. As soon as the plant was in place, the electrician and dose pump technicians moved in. Dose pumps and pipes were installed in one day and tested the next. Some work between the two contractors to get the pumps and bores talking to each other was quickly undertaken. The fencing went up just as quickly and the painting and bore perch repairs were done in between other projects over the next few weeks. It was great to see the finished product from concept to completion (Figures 2, 3 and 4).

We came in under budget, not by much, but with the need to upgrade switchboards, dose pumps and flow meters it increased the build cost considerably. The sharp, clean and professional looks of the new dose plant reflects the Gunnedah Shire Council approach to water quality management.

In the future, the dose plant will be relocated to a new site where it will ensure the small community of Curlewis has safe drinking water piped direct from Gunnedah.

The Author

Brock Stone (brockstone@infogunnedah.com.au) is a Water Quality Officer with Gunnedah Shire Council in New South Wales.

Figure 2. The new Curlewis dose plant external view.

Figure 3. The new Curlewis dose plant internal view.

Figure 4. And security fencing.

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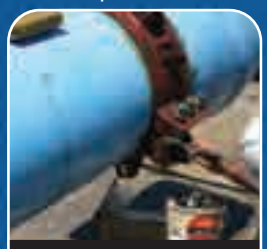

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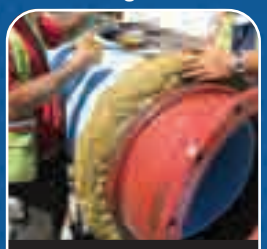

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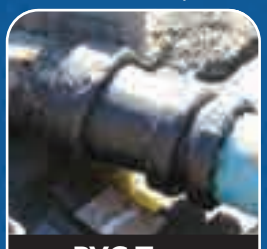

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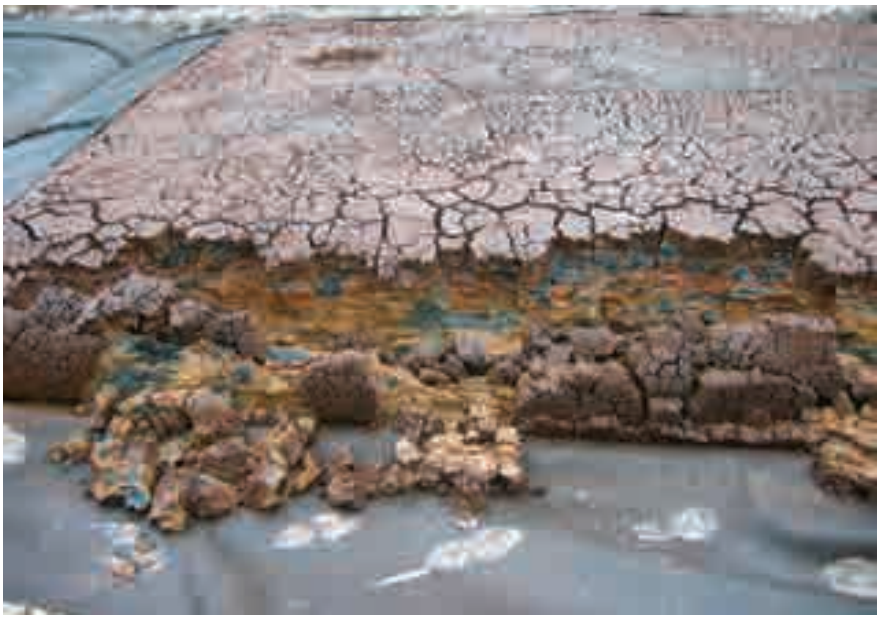
- tunnelling groundwater treatment.



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Correct polymer selection for sludge conditioning prior to the dewatering stage is the most critical activity to get right. This stage maximises economic return, solids capture, filtrate quality, dewatering rate, shear stability and polymer application strategy of the conditioned sludge through the tube. Poor selection tests jeopardise project outcomes. CRS strongly recommends this prerequisite.

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- ✔ NO affect from rain
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CRS provide a complete sludge management solution: Sludge pond survey, polymer testing, dredging, dewatering into the Envitubes®, dry biosolids management. Envitube® customers have included Caltex, BMA, Centennial Coal, Taronga Zoo, Sydney Water, BP, BHPB, RIO across Australia. CRS offers proven, unmatched experience with Envitubes® for passive dewatering of diverse sludges.

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WATER TREATMENT . HIGH SALT OR HIGH SOLIDS . IT'S OUR BUSINESS

BIOREACTOR MIXER BASE PLATE REMOVAL TOOL

Winner of the Iwaki and Nalco Awards for the Best Paper presented at the 2017 WIOA Qld Operations Conference

Marcus Boyd

The Wetalla Waste Water Reclamation Facility is owned and operated by the Toowoomba Regional Council. The facility is a University of Capetown (UCT) Biological Nutrient Removal (BNR) process treating an Average Dry Weather Flow (ADWF) of 36 ML/d. The plant consists of two identical Bioreactors operating in parallel. Bioreactor 1 was commissioned in 1995 while Bioreactor 2 was commissioned in 2006.

Each of the Bioreactors has 14 mixers in place (Figure 1).

Biannually the mixer masts are removed for inspection, fitting of sacrificial anodes, and an application of a protective coating for corrosion control. During the biannual maintenance program, maintenance staff noticed significant wear on the mixer mast locating pins (Figure 2).

There are 14 mixers in each Bioreactor, and all the locating pins had evidence of similar wear. Each pin was repaired to original specifications in the workshop (Figure 3). However, given the extent of the wear observed on these pins, there were serious concerns expressed regarding the integrity of the base plates themselves. Maintenance staff had also noted that during their operational life, the base plates had worn to a point where the masts were required to be rotated 90° to allow removal. This 90° rotation was necessary to free the mast from the groove that had worn into the base plate.

Each mast locates into a base plate fixed to the Bioreactor floor.

The base plates have a locating cone on top to assist locating the mast pin into the base plate fitting. Many of these were worn and in some cases completely missing (Figures 4 and 5).

The wear on the base plates and locating pins was a result of constant rubbing caused by the normal operation of the mixers, combined with the abrasive nature of the fine grit within the wastewater. This rubbing had been continuous for the past 22 years.

Figure 1. One of the Bioreactors showing the location of one of the mixers.

Figure 2. A mixer mast removed from the Bioreactor showing the locating pin (arrow).

Figure 3. An example of a repaired locating pin.

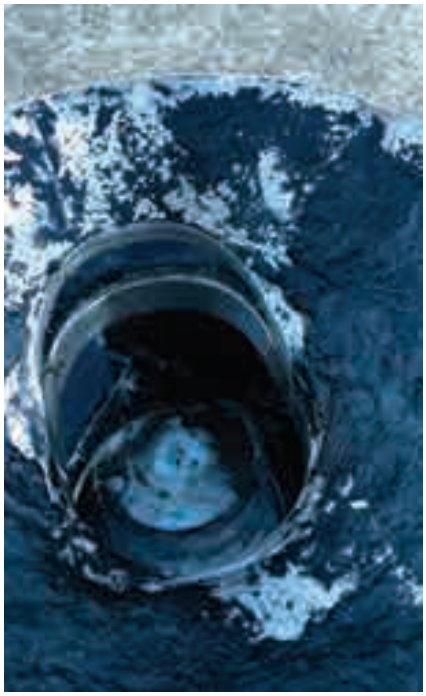

Figure 4. An example of a worn baseplate.

The mast locating pins were repaired when required, while the base plates continued to wear. Approximately 18 months ago, it became apparent the base plates would need to be replaced.

An in-situ inspection of all the baseplates was not possible as the Bioreactor could not be taken offline without causing problems to the process. To work around this restriction, a commercial diving contractor was engaged to remove a single baseplate for inspection. The first attempt to remove a baseplate failed as it had locked onto the anchor bolts, making removal impossible without any specialised tooling.

Unable to inspect the base plates, concerns were raised as to how long the baseplate could remain in service before a critical failure occurred.

Given the requirement for effective mixing in the Bioreactor, a critical failure was not an option. Initial investigations took place into taking the Bioreactor offline and replacing the baseplates. This process proved to be expensive ($130,000+), while potentially compromising final effluent discharge, licence compliance requirements as well as the unnecessary disruption involved with taking a Bioreactor offline.

While the investigation was underway to take the Bioreactor offline, the 14 replacement baseplates were procured from the original supplier (Figure 6) because the time to order and fabricate the new baseplates was 16 weeks.

By the time the new baseplates had arrived, it became clear the proposed option of taking the Bioreactor offline would not be possible. At this point I was looking at the new baseplates and thought "I could make a tool to lift them within the Bioreactor". Having the new baseplates on site made it easy to come up with a solution as there was something to "touch and feel". Prior to the arrival of the new baseplates, only engineering drawings were available.

A meeting with the on-site fitters was held and we started designing the lifting tool using a new baseplate as a reference point. After the lifting tool was constructed, a baseplate was bolted and glued (using Sika Flex), to the concrete in the car park. We did this to operate and test the tool as close as possible to the real application. The testing scenario was successful and became useful when divers were engaged.

Figure 5. An example of a worn baseplate actually missing the locating cone.

Figure 6. The new baseplates.

Figure 7. Testing the baseplate lifting tool.

The dive crew could see the tool in operation prior to the actual replacement task commencing, which was extremely beneficial as there is zero visibility at the bottom of the Bioreactor.

The final result was a lifting device, which was lowered to the baseplate using the onsite jib crane. A diver secured the lifting tool to the worn base plate using a locking pin. The height of the lifting tool could be adjusted with wing nuts and a hydraulic ram was fitted to each end of the lifting tool connected to two hydraulic pumps. Each pump had a visual gauge so the operator could watch the hydraulic pressure and maintain even pressure on each ram (Figure 7).

The idea was to make the tool as easy as possible for the diver to operate. The diver's task involved removing the anchor bolts and guiding the lifting tool into position, securing the locking pin and adjusting the stabilising legs. Once the lifting tool was fitted, the diver moved away while jacking took place. The diver had full audio communication with the fitters above, which was essential for the safety and accuracy of the project. The hydraulic rams on the lifting tool had 25mm travel so a few ram height adjustments were required to clear the baseplate of the anchor bolts. The diver could feel if the baseplate was lifting off square and re adjust the wing nuts after each lift. When the plate was jacked off the anchor bolts, the lifting tool and base plate could be raised to the surface using the jib crane. This was possible as the lifting tool was still attached to the base plate with the locking pin (Figure 8).

The day came to put the lifting tool to work. We had planned the project to take 5 days. The first baseplate was removed before morning tea, and there was relief to see the base plate was as worn as expected and was in need of replacement (Figure 9).

Removal of all 14 baseplates was completed in three and a half days. Each baseplate showed varying levels of wear depending on the load they were subject to.

All 14 baseplates have now been replaced and will be in service for the next 2 decades. The replacement project was estimated to cost in excess of $160,000 if the Bioreactor was taken offline. By using the baseplate removal tool, the project was completed for less than $40,000.

The Author

Marcus Boyd (marcus.boyd@tr.qld.gov.au) is a Senior Technical Officer with Toowoomba Regional Council in Queensland.

Figure 8. Removal of first baseplate attached to the jib crane.

Figure 9. Worn baseplates removed from service.

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HDPE poly has been available for more than 50 years, and until recently, butt fusion and electrofusion have been considered the top joining methods for this piping material. But fusing requires installers to be properly trained and certified; in order to achieve a high-quality fuse, installers must be experts in pipe preparation and fusing techniques – including the facing, scraping and cleaning of pipe ends, and fusing itself.

'Finding a certified installer is a challenge. While the war for talent continues to intensify as HDPE adoption increases, identifying qualified installers is also difficult.

'In a complicated regulatory and accreditation environment, it's difficult to navigate the range of certification programs and accreditation schemes. A simple Google search for butt fusion and electrofusion training programs returns dozens of online results. The question is, how do you know your installer is truly certified?' says David Sharkey, Victaulic Vice President and General Manager of South Asia Pacific.

In this complex landscape, Victaulic, the world's leading producer of mechanical pipe joining solutions, has developed a Watermark™-certified mechanical joint for HDPE piping. The solution is set to increase installation efficiencies and overcome the certification requirements traditionally associated with HDPE fusion and installation.

Widely accepted for use on steel pipes, mechanical joining can be installed up to 10 times faster than fusing. With no special certifications required and minimal pipe preparation needed, mechanical joints can be installed through the simple act of tightening two nuts and bolts.

In traditional fusing practices, the expense of fusion equipment, and the shortage of skilled installers, can slow the pace of installation. In the event that equipment breaks, work may come to a complete standstill.

In stark comparison, mechanical joints eliminate the need for expensive fusing equipment, power sources or certified fusion installers. This means skilled workers can be deployed to more demanding areas of a project.

Additionally, without the need for complex equipment, mechanical joints can be quickly installed in tighter spaces and places that traditional fusing gear can't reach.

With no need for fusion tents, no concerns about contamination of pipe ends, and no extra heating or cooling time during extreme weather, pipe installation processes become streamlined and hassle free. For remote projects located in some of Australia's harshest environments, the ability to complete projects without weather delays will ensure both operational and cost benefits.

'As leaders in the mechanical joining business, we are extremely proud of the Victaulic Refuse-to-Fuse™ solution for HDPE pipe. We understand the mining industry is looking to create efficiencies in their workforce and operations, and mechanical joining answers this need. We're excited by the potential benefits and savings that can be achieved by switching from fusion to mechanical joining in water infrastructure projects,' Sharkey says.


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MANAGING WORKFORCE FATIGUE

Kirsty McCulloch and Michelle Riley

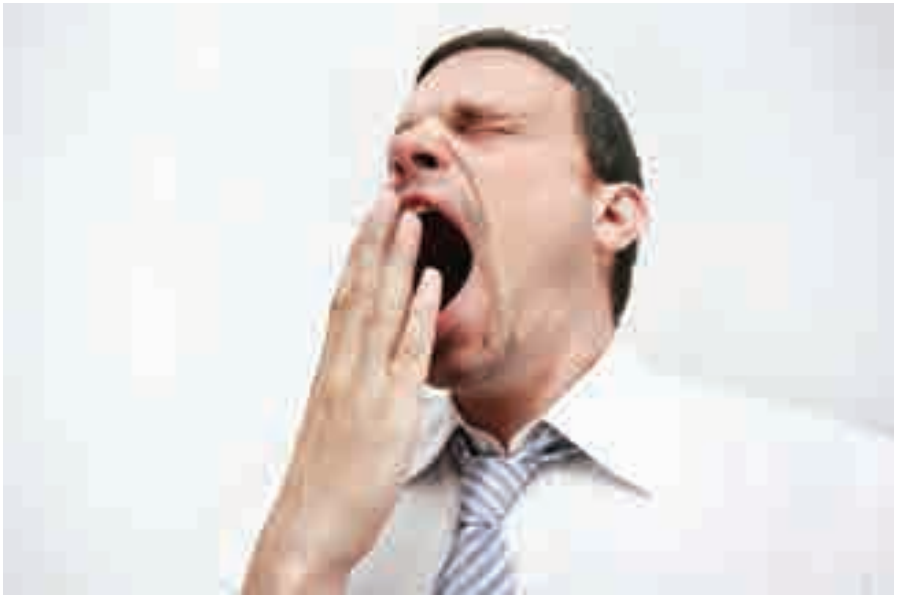
Preventing and managing fatigue is a challenge facing most water companies in Australia. Water supply and sanitation is an essential service, requiring 24-hour operations. This often involves on-call duty cycles, with operators working day shifts as well as callouts across the night; long shifts to cover workload; and incident response to maintain or restore supply as quickly as possible when broken. These conditions can have a significant impact on sleep, the consequences of which are often underestimated.

There are also many personal circumstances that impact on sleep and workplace fatigue. Many choose to sacrifice sleep for activities such as sport, or social events. People stay up late searching the internet or gaming. Top-rating television shows are now available on demand promoting a culture of "binge watching" at the expense of sleep. Often, personal circumstances, such as young families or medical conditions, are deemed "part of life", where people resign themselves to poor sleep or fatigue, rather than finding management strategies.

Sleep is an essential part of human functioning.

In our early evolution, the cycles of the sun and moon and the seasons defined to a large extent our sleep patterns. Society valued sleep, and slept on average 9 hours a night. In the early 1900s, Thomas Edison introduced the electric light bulb, allowing productivity and wakefulness to invade the night time. Edison was known to have said "sleep is a criminal waste of time". Since then, technology has boomed and we have created a world where we are stimulated 24/7, and the average amount of sleep we obtain as a population has been in steady decline.

The Australian Sleep Health Foundation has recently published evidence that sleep deprivation has become a national



epidemic. Up to 45% of Australians have poor sleep patterns, which lead to unsafe behaviours, low productivity or "presenteeism" (being present but not productive), and long-term damage to their mental and physical health. Another recent study of over a thousand Australians by the University of Adelaide found:

- 44% of adults look at the internet just before bed every night – and most of them experience sleep problems.
- 20% of adults had fallen asleep behind the wheel within the last 12 months, with 5% experiencing a vehicle accident including where the driver ran-off-the-road or crossed lanes.
- Almost a third of adults (29%) reported making workplace errors due to sleepiness or sleep problems within 3 months of the survey.

Fatigue has been cited as a contributing factor to many major disasters, including Chernobyl (1986), BP Texas City (2005), Michigan Train Wreck (2001), and the Buncefield Oil Depot Explosion (2005). The contribution of fatigue has included performance impairment such as slower reaction time, reduced vigilance and decision-making ability, poor judgment, distraction during complex tasks, and loss of awareness in critical situations.

As shown in Table 1, one study showed a direct relationship between sleep quantity and the risk of injury.

Lack of sleep can also have a direct impact on the health of the individual. People experiencing long-term sleep loss are also more likely to suffer from chronic illness such as obesity, diabetes, cardiovascular disease, or cancer. There are also links to Alzheimer's disease and dementia. Even over a short period, people who get less than 6 hours sleep per night have lower immune system function, and are 3 times more likely to get a cold than those who average 8 hours sleep a night.

Fatigue also has a significant effect on business performance. Table 2 lists some of the business impacts of tired employees.

Businesses are starting to realise that well rested people are better employees.

	Estimated Annualised Injury Rates/100 Workers					
Hours of Sleep	<5	5-5.9	6-6.9	7-7.9	8-8.9	9-9.9
Injury Rates	7.89	5.21	3.62	2.27	2.50	2.22

Table 1. The relationship between injury rates and hours of sleep.

	Well-rested employees	Tired employees
Safety	Make fewer errors, and take fewer risks	Make more errors, take more risks
Productivity	More productive through increased team focus and workload management	Less productive due to social withdrawal, and general mental and physical impairment
Absenteeism	Healthier, more resilient and less likely to be absent	More susceptible to poor health, stress and absenteeism
Presenteeism	More engaged, proactive, and achieve more during each work period	Likely to experience lower morale, and achieve less during each work period
Work life balance	Lead more balanced lives	Struggle to balance responsibilities
The bottom line	Contribute more	Cost more

Table 2. Business impacts of tired employees.

Melbourne Water Fatigue Study

In 2015, Melbourne Water commenced a Workplace Fatigue Project to analyse the extent of fatigue-related impairment across the workforce.

Over 50 operators completed a questionnaire, asking about their perceptions of fatigue and sleep disorders.

Employees were issued with fatigue diaries and Fitbits to measure actual work hours, sleep and symptoms. Thirty-nine employees completed the fatigue diaries and Fitbit data.

All existing rosters were analysed using a fatigue modelling program.

The sleep diary and Fitbit data demonstrated good overall sleep practices of Melbourne Water operators. The majority of operators exceeded 6 hours sleep per day across most shifts. However, there were examples where some had far less. Table 3 shows the average sleep obtained by operators for each various shift type, including the range of sleep.

Even on day shift, typically due to call outs, the minimum sleep obtained was 2.5 hours, and on night shift, the minimum was less than 1 hour. In each of these cases, the individual chose to work the following day. This is evidence of a 'push through' culture often present in motivated operators aware of their responsibilities to their customers, where they believe they are doing the right thing by doing the work themselves and not inconveniencing others. Operators were extremely unlikely to stop and ask for help, or defer work until they were fit to complete it. Rather, they opted to push through feelings of fatigue until the job was done. There were instances of operators taking multiple calls throughout the night, and still arriving at work for a full shift the next day, often for multiple days in a row. There were instances of operators starting their shifts very early in the morning (0400), and remaining on site for the entirety of their shift, again for multiple days in a row. In each case, the event could be pointed back to a plant upset, or an unexpected incident. However, these types of incidents while unexpected, are not uncommon, and require proper management to prevent fatigue-related error, to ensure the individuals are well rested for their remaining shifts.

This requires significant education on the short-and long-term risks associated with this type of sleep loss, as well as realistic, management endorsed strategies that can be used in these situations.

The roster analysis showed a number of findings:

- The base day Monday-Friday rosters for water supply teams produced low levels of fatigue likelihood. However, due to the structure of availability / on call periods, operators worked up to 11 consecutive days.
- Work groups that started at 0700 scored significantly better than those starting at 0600 or 0630.
- Some teams maintained a rigid start time throughout their availability period, including weekends.
- The shift roster at Eastern Treatment Plant was a 'red flag', posing significant fatigue-related risk. The roster was 'backwards rotating', from nights, to afternoons and then days, which is known to disturb sleep and performance more than forward rotating rosters. The roster also involved long blocks of up to 11 consecutive shifts, which were extremely complex with low predictability. These factors are known to increase absenteeism and further exacerbate fatigue.

Some opportunities for improvement based on the roster analysis are immediately apparent:

- Having the flexibility to start later when on call and modify routines on weekends, and as required based on night time calls on other days to reduce fatigue likelihood. The concept of later start times, particularly during availability periods, would significantly reduce fatigue likelihood.
- Starting availability on a different day, or splitting it into shorter periods would significantly reduce the likelihood of fatigue.
- Use of forward rotating rosters i.e. from day to afternoon and then nights.

	Average (hrs)	Range (hrs)
Dayshift	6.8	2.5-8.5
Nightshift	7.1	<1-8
Afternoon shift	8.1	4-12
Early shifts (pre 0600)	5.8	3-7
Non-work periods	7.3	5-12

Table 3. Average, minimum and maximum sleep durations across various shift types.

Changes at Melbourne Water

Since receiving the study results, Melbourne Water has been working hard to implement measures to better manage fatigue.

1. Changes have been made to the Eastern Treatment Plan shift roster to a 12 hour roster and these now forward rotate from day to evening.

   Now operators report better wellbeing with one making the statement at a recent team meeting that "we should have done this years ago".
2. Water supply teams have changed their roster start day, starting times and their philosophy to the duties of the on-call operator. Originally the on-call operator tended to have the most difficult duties on roster. Now, they have the easiest duties to ensure they are not overly fatigued during the day and to allow for more flexibility for later start times if there are issues overnight.
3. One of the greatest improvements has been around the "push through" culture with significant improvement in operator awareness and understanding.
4. Modification of the Melbourne Water fatigue procedure to include understanding of the personal safety, productivity and health risks of fatigue and personal management strategies.
5. Provision of organisation wide training and an internal communications campaign.

One of the most alarming results from the study was that potentially 75% of staff are at risk of moderate to severe sleep apnoea. "At risk" staff have had the opportunity to be referred to sleep clinics, fully financed by Melbourne Water.

Where to from here?

Society in general needs to reverse the notion that being awake for longer makes us more productive, and that we can somehow avoid the health and safety repercussions of sleep deprivation.

Water Companies can and should take a number of steps to reduce the financial, legal and health consequences of a sleep deprived workforce. The water industry can maintain flexible work hours, while maintaining a scientifically-defensible approach to managing the risk of fatigue.

If we think that we don't have time for sleep, we are wrong. The reality is that we do not have time for all of the negative consequences associated with this hidden hazard.

The Authors

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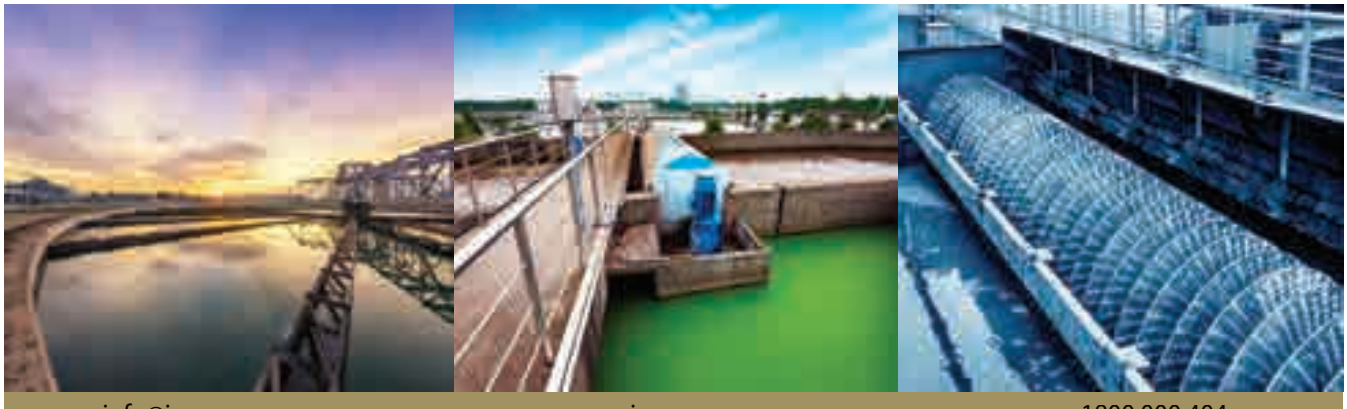

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SCHOOL BASED APPRENTICESHIPS FOR WATER INDUSTRY OPERATIONS

Winner of the Hepburn and Nalco Awards for the Best Paper Overall presented at the 2017 WIOA Victorian Operations Conference

John Day

North East Water has communicated through its People Strategy that we are committed to creating a more diverse and inclusive organisation that better reflects the communities that we serve. Workplace diversity relates to many areas, such as race, gender, age, religious belief, disability and sexual orientation.

Our People Strategy is focusing on the areas that are a current priority and that align with the Victorian Industry Diversity Strategy.

A number of key priorities underpin the Strategy:

- Women in the workforce
- Opportunities for Aboriginal and Torres Strait Islander people
- Understanding the needs of an intergenerational organisation
- Supporting a flexible and empowering workplace
- Inclusive and respectful organisation.

To achieve these goals, North East Water has set a target to increase our female outdoor staff numbers by 10% by 2019.

We have always faced difficulties attracting females to apply for our outdoor positions. While promoting diversity, delivering on our promise of this goal has always met the same outcome - that no females apply for the advertised positions. Changing the titles and the sound of the advertisement still provided a poor result. The advice we were given by other Water Corporations was that by changing the titles and making the roles sound less specific i.e. must have an NWP Certificate 3, we would attract more female applicants. Sadly, whatever we did, things didn't work as planed with no females applying.

We needed to rethink the problem. Conversations with local Secondary Colleges identified an opportunity through the Victorian Certificate of Applied Learning (VCAL) program. The local College's also had trouble attracting

Figure 1. Tayla Cartwright (L), Patricia Rokahr, North East Water and Jasmin Boland

females to their VCAL program in part because of limited options for them other than hairdressing or hospitality.

The VCAL program is open to year 11 and 12 students who are looking for two days a week work experience in their chosen field and three days a week traditional classroom activities.

The Colleges' found that by connecting to a Water Corporation under our NWP Certificate training modules, they could offer more to their female students in a science and trade based outcome than they currently could. Additionally, while at North East Water, the student would complete their NWP Certificate 3 in either water or wastewater treatment operations.

North East Water has now partnered with Wodonga Catholic Colledge (WCC) and their VCAL program to encourage female school leavers to work in the water industry and more specifically in operations.

What was attractive to North East Water was that the College would choose 4 female applicants to be interviewed for the newly created apprenticeship role. This meant that they knew the students well and understood their abilities as well as their suitability to the role. WCC also wanted the program to succeed to show an alternative to the current work placements on offer, which would then attract more students to stay at school and complete their year 12 education.

Selection of the first candidates involved an extensive interview process which included tours of the water and wastewater treatment plants with the student and their parents, and an informal conversation about the role. North East Water selected two candidates, one for our water treatment stream and the other for our wastewater treatment stream, both based in Wodonga.

The two students are in year twelve and work two days a week in their first year, then fulltime in their second year. They complete all of their learning by correspondence work in their first year through Riverina TAFE and the Water Industry Training Consultants (WITC). In their second year, they complete their training in Geelong at the WITC facility. While in their first year, there is monthly check-ins with the College to ensure that the students have what they need and that they are successfully completing their year 12 studies.

This project has now been running at North East Water for six months and there have been several learnings.

To work with teenagers you need new skills in how to coach a school leaver. WCC have been a fantastic help, running a half day course for our operators on dealing with teenagers, something they have found even helps them at home.

It doesn't suit everyone. We have had one of the students pull out as she just didn't see herself working in our industry, but she did enjoy the time with us.

There are plenty more to follow. Even though one didn't work out, there were others very keen at WCC to take her place.

It has raised interest at the College by other school leavers now looking to do work experience with us.

With the apprentice only working two days a week it is better to combine the two days together at the start of the week for a better flow of work.

The pilot program has been very rewarding for North East Water by opening an avenue for female employees to enter our outdoor operations. It has however been a drain initially to get the program up and to set weekly routines for the girls. Now that this has been defined, next year's applicants will find it more settled and our operator's will better know what to expect.

For WCC, it has opened up an opportunity for female school leavers to enter into another stream other than the traditional offerings, which has in turn raised the profile of the VCAL program.

Currently, we are working with Riverina TAFE to secure government funding to lower the cost of the training which is around $10,000 per student to complete the Certificate 3, plus accommodation and expenses.

An interesting consequence of our program has been that other large manufacturing businesses in Wodonga have joined the program.

North East Water are now currently working with other Victorian Water Corporations who are trying to achieve the same goals as us, while facing the same issues in attracting female operation staff.

The Author

John Day (JDay@newater.com.au) is Executive Manager Operations, with North East Water in Victoria.

Editor's Comment

Programs that encourage young people to join the water industry are to be applauded, given the industry's generally ageing workforce. Programs that support more female participation in our largely male-dominated industry should also be supported, along with programs that improve opportunities for those with disabilities, or who suffer from disadvantage of one sort or another. An inclusive industry can become an innovative industry.

The program described in this article is not the first program that has sought to increase female participation in the water industry, and it is unlikely to be the last. Hopefully, part of this program will examine why there is generally a low rate of retention of females in the industry, so that potential barriers can be addressed, and mistakes of the past are avoided.

THE POWER OF 2

Editor's Comment
While the following article relates to female engineers, the lessons learnt may well be applicable to females in water industry operations.

It's human nature to feel more comfortable working on projects with people similar to yourself and an American study demonstrates quantifiable results for female engineering students.

The study, titled "There Is No 'I' in Team: Peer Effects in Engineering", was conducted by researchers from Wake Forrest University in North Carolina and Purdue University in Indiana.

It looked at the performance of students in introductory engineering classes, whose demographics were typical of a selective engineering program, with few female and minority students, and a high number of international students.

The students prepared for class by watching lectures and completing assigned reading. During Class, they worked in randomly selected groups of four to create a design, such as a toy for use in preschool classrooms.

When female students worked with at least one other female in their group, their course grade was higher than those without female peers in their group.

The study authors found that female engineering students who were paired with other females were also more likely to build up sufficient interest in engineering to declare an engineering major at the end of their first year – a critical step in getting more women to pursue careers in science, technology, engineering and maths (STEM).

"We definitely see benefits for women not being alone in this type of setting," said Amanda Griffith, an associate professor at Wake Forrest University, who specialises in challenges facing women in STEM programs.

"What's going on here could be happening in other engineering settings like this, both in and out of the classroom."

The next step is to see if the effect carries over or compounds during the second course in the engineering sequence, where students are reassigned to project groups, or in professional engineering settings. Griffith also wants to see if working with same-gender peers influences whether women graduate with an engineering degree and purses careers in engineering.

Photo courtesy of wocintechchat.com.

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We have certainly learnt a lot about its capabilities; for example, we know that by supporting the planning of a mains flush and working with clients to understand the locations of valves and hydrants, we can achieve significant rates of cleaning per day. This has been a significant learning curve for us and our clients, and we have reaped significant benefits when using such a collaborative approach. Our average daily clean using the loop approach, as depicted above, can see around 5.5–6 kilometres cleaned daily.

We have removed significant levels of sediment and biofilms from water mains of varying sizes, and have seen great results removing turbidity and increasing chlorine residuals, as the NO-DES unit can also add a residual back into the network safely and methodically.

The use of the NO-DES unit provides significant benefits: no water is wasted during the process; there is no environmental discharge to plan and cater for; the system remains online, keeping customers in supply; and the unit is portable and simple enough to establish without significant traffic control and customer interface.

With support from the client, the NO-DES unit can easily achieve flows of more than 120 litres per second; it's able to clean water mains at a velocity of more than 1.5 metres per second. A recent project at a busy airport in Queensland saw flows of 122 lires per second removing sediment and biofilm from a 415-millimetre water main and providing a chlorine residual upon completion. The unit was so successful in removing the biofilms that it's due back in a few weeks to flush more assets for the client.

The technology and our collaborative approach to mains cleaning is now becoming accepted by forward-thinking utilities as a useful and effective tool when dealing with issues such as nitrification, elevated turbidity and low chlorines. The unit itself can be mobilised very quickly, and is completely self-sufficient. We can be on site within 24 hours of your call, and in most cases, even less.

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For more information, visit aussietrenchless.com.

TO BOIL OR NOT TO BOIL?

David Sheehan

One of the more stressful times for those of us involved in the provision of safe drinking water is responding to the detection of the faecal indicator bacterium *Escherichia coli* (*E. coli*) in treated drinking water. Finding out that *E. coli* bacteria are present in the drinking water that you are supplying to the public is never a good thing, and every detection must be investigated and responded to. But what is the correct response, and should every detection automatically result in a Boil Water Notice being issued?

The purpose of this article is to suggest a risk-based assessment process that can help operational staff gather relevant information to allow them to decide what to do and whether the issuing of a Boil Water Notice should be considered. The information gathered during the assessment process should also be shared with your health regulator to assist with managing the response to any *E. coli* detection.

Detecting *E. coli*

Currently, *E. coli* is the best indicator we have for determining whether the drinking water we are supplying contains faecal contamination. *E. coli* bacteria are present in extremely high numbers in the faeces of all warm-blooded animals, so you only need a very small amount of faeces to have potentially millions of *E. coli* released into the water.

Luckily, *E. coli* generally do not survive in water that well, and they are also easily killed by chlorine, but it also takes around 18 hours from the time a laboratory starts processing a sample to get a result. This means that by the time operational staff are advised of a positive result, potentially contaminated water could have been flowing through the water supply system for at least 24 hours.

Therefore, if *E. coli* are found in a treated drinking water sample, it is a cause for concern, and any detection must result in a thorough investigation of the water supply system where the detection occurred.

Whilst it is a cause for concern, and must prompt an immediate investigation, to quote the Hitchhikers Guide to the Galaxy – "Don't panic". *E. coli* can sometimes be present in drinking water samples and the drinking water is not contaminated and is still safe to drink, but whether the drinking water is safe or not can only be determined after a thorough investigation has been completed.

The following sections detail what information and data should be reviewed as part of this investigation.

Time is of the Essence

By the time a positive result is supplied to operational staff, it is already around 24 hours since the sample was taken, so investigations should start straight away. If investigations cannot be commenced straight away, then it needs to be decided what should be done as a precautionary measure until the system investigation has been completed. This may include consideration of the issuing of a precautionary Boil Water Notice, but this should be considered as a last resort, as most of the information required for the investigation should be easy to gather.

Is there a certain number of *E. coli* that should automatically trigger the issuing of a Boil Water Notice?

This is a really tricky question. For example, if the automatic *E. coli* trigger value for issuing of a Boil Water Notice is set at 100 organisms/100 mL, and the result from the laboratory is 99 organisms/100 mL, or 90 organisms/100 mL, does that mean everything is okay?

Generally speaking, a result of 100 organisms/100 mL is not ten times worse than a result of 10 organisms/100 mL, but since most *E. coli* detections in treated drinking water are usually 1–2 organisms/100 mL, a result of 100 organisms/100 mL is likely to be a sign that there is a serious contamination issue in the water supply system.

The thing to be careful of here is that if you link your response to just the number of *E. coli* that have been detected, you may lose the ability to apply a risk-based approach to assessing what the appropriate response should be.

A more useful criteria would be to look at how many sites have returned positive *E. coli* results – e.g. *E. coli* detected at a Treated Water Storage (TWS), plus customer tap site(s) supplied by that TWS, on the same day – potentially, a big issue; *E. coli* detected at one customer tap site, or just the TWS, may not be so much of an issue.

While detections at multiple sites across a water supply system potentially indicate a significant problem, it may not be sufficient to automatically trigger a Boil Water Notice.

The following section details the things that need to be assessed to determine whether a Boil Water Notice should be issued based on an initial detection of *E. coli*.

Assessment Process

The following is a simple checklist of things that should be checked in response to an *E. coli* detection.

Chlorine residual at the time of sampling (and currently)

The adequate amount of chlorine will vary from system to system, but if the measured free chlorine residual is < 0.2 mg/L in a chlorinated system or the total chlorine is < 0.5 mg/L in a chloraminated system, it is unlikely to offer any protection against bacterial and viral contamination. If it is suspected that the source of contamination may contain protozoan pathogens, such as Cryptosporidium, then raising the chlorine residual will not address the problem, as Cryptosporidium is resistant to chlorine.

Turbidity at the time of sampling (and currently)

Was the turbidity at the time of sampling unusually high for this site or this water supply system? If it was unusually high (for example turbidity values > 2 NTU), this could indicate that contamination of the system has occurred.

System issues (mains breaks/mains repairs during past 48 hours)

Has there been any mains breaks/mains repairs in the immediate vicinity of the site where *E. coli* was detected? If there have been any breaks or repairs, this may indicate a possible source of contamination.

Tank integrity

A common source of contamination are TWS tanks. If the *E. coli* detection occurred at a TWS, the tank needs to be thoroughly inspected for possible points of contamination. If the detection occurred at a customer tap site, any upstream tanks need to be inspected.

Performance of treatment processes at an upstream water treatment plant (check SCADA records for past 48 hours)

The performance of the treatment processes at the water treatment plant that supplied water to the sites where *E. coli* was detected need to be reviewed to check for any failures in any of the treatment processes. This review would look for such things as unusual turbidity spikes post the clarifier or post the filters, breaches of critical limits at any Critical Control Point (CCP), failures of any chemical dosing systems, or any loss of power or maintenance activities that could have adversely affected the performance of the WTP.

If any of the above inspections or investigations identify a major loss of control of the system, and these issues cannot be rectified within 2–4 hours, the issuing of a Boil Water Notice should be considered at this stage.

The rationale behind the 2–4 hour time recommendation is that it will often take 2–4 hours to put a Boil Water Notice in place, and it can be just as efficient to take steps to rectify the issue as it is to issue the Boil Water Notice. If it is going to take longer than 4 hours to fix any identified issues, the protection of public health becomes more important, and this can be addressed by the issuing of a Boil Water Notice.

If the investigation finds that the chlorine residual is low or non-existent, if you can, spot dose the system with chlorine (at either at the TWS, or directly into the water main), or flush the system to bring chlorinated water with a minimum free chlorine residual of 0.2 mg/L into the system within the next 2–4 hours.

Again, if you cannot raise the chlorine level to above 0.2 mg/L within the stated time period, and especially if you have recorded multiple positives across several sites, a Boil Water Notice should be considered at this stage. If the chlorine residual can be raised within the time period, there is likely to be little health benefit from requiring customers to boil adequately chlorinated water.

If the system has been inspected and assessed, and no problems have been found, then it is highly unlikely that a Boil Water Notice would need to be issued at this stage, based on one set of positive *E. coli* samples. The next action should be to collect additional samples for *E. coli* analysis, from the site where the original detection was recorded, and several other points from across the water supply system.

Similarly, if an issue was found, collect additional samples for *E. coli* analysis; if possible, samples should be taken before any remedial action is taken, as well as after any remedial action, but do not unnecessarily delay the starting of remedial action just to collect the pre-action samples – fixing any identified issues is more important than collecting samples.

Be particularly careful to ensure good sampling techniques are used. The sample bottles that are used must be sterile, must contain sodium thiosulphate, and the sample must collected in a way that avoids the sample or the bottle or the cap of the bottle from becoming contaminated. The sample esky and ice also need to be free of any contamination. Any samples that are collected need to be promptly sent to your NATA-accredited laboratory for analysis.

If either the samples that were collected from a system where no problems were found, or the samples that were collected after remedial action had been taken, return any positive results for *E. coli*, then a Boil Water Notice should be implemented. The water supply system is unlikely to be under control, even after remedial actions have been taken, and public health needs to be protected. It also indicates that *E. coli* have been present in the system for greater than 48 hours, and that is clearly unacceptable.

In summary, unless there is a readily-identifiable serious system failure, it would be highly unlikely that you would initiate a Boil Water Notice until you have two consecutive sets of samples that have recorded positive *E. coli* results.

One final thought - during all the investigations and inspections, the question that needs to be continually asked by operational staff and managers is, "Do I believe the water being supplied is safe to drink"? Or, put another way, "Would I be happy to let my family drink the water that we are currently supplying to our customers?" If, at any stage, the answer is "no", then issuing a Boil Water Notice needs to be seriously considered.

The Author

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"WE'VE NEVER HAD PROBLEMS BEFORE" CAN BE A PROBLEM

Dave Yarin

The hours ticked down to launch time, and Roger Boisjoly had the weight of the world on his shoulders. It was January 1986, and the highly respected rocket engineer and thermodynamicist at Morton Thiokol was pleading with his supervisors and NASA to postpone the launch of the space shuttle Challenger on that unusually cold Florida day.

Icicles extended for hours from the shuttle and the launch platform, and NASA had never before launched in such cold weather. In fact, it was 15 degrees colder on this day than on any prior shuttle launch.

Boisjoly presented hard data and evidence to support his point – that the O-Rings on the shuttle's solid rocket boosters would fail, leading to an explosion, the loss of the Challenger and the astronauts on board. Boisjoly had written a memo less than one year earlier about the clear evidence of the O-Ring failure following a prior launch, and he was concerned that the extreme cold temperatures on the morning of 28 January would lead to a disaster. Other Morton Thiokol engineers had also expressed concerns about the O-Rings in a memo written seven years before the Challenger launch.

How did NASA incorporate normalisation of deviance into their decision-making processes?

NASA and Morton Thiokol convened a teleconference in the hours leading up to the launch, and NASA pressed Morton Thiokol for data to prove Boisjoly's concern. This was an odd shift for NASA personnel, who historically required their engineers and contractors to have evidence that launching was safe; but now, they asked Morton Thiokol to prove why the launch wasn't safe.

In the teleconference, Boisjoly described the data from previous launches that showed O-Ring failure, and at one point, a pause in the discussion gave him hope that his concerns were being heard. Suddenly, however, Thiokol senior management asked the engineers to leave the room, and Boisjoly's heart sank. He knew this meant that senior management wanted to go over the engineers' heads and recommend launching to NASA.

Not only was Boisjoly dismissed from the room, but his warnings were dismissed as well. He sat in his office and waited while the countdown commenced, believing that the O-Ring failure would cause immediate explosion after the rocket engines ignited on the launch pad. Boisjoly was temporarily relieved, however, when the Challenger lifted off without incident. But 73 seconds into the launch, as Challenger went "throttle up", he was inconsolable when the shuttle exploded. Employees came to talk to Boisjoly, but he found himself so stunned that he was unable to speak. The months and years that followed led to depression and his inability to work.

There were so many questions he wanted to address about the explosion of the shuttle and the loss of the seven astronauts on board – most importantly, "Why didn't they listen?"

What Boisjoly didn't realise at the time was how much he was up against. He had more than just his Morton Thiokol superiors and NASA supervisors to convince; he was also fighting a battle against human nature.

The space shuttle Challenger, seconds before it exploded. Photo: NASA; CC Wikimedia

He had all the right data, all the correct technical explanations – he had even identified the very problem that would cause the shuttle to explode. But on the cold January day, it was understanding social psychology that could have been his best weapon.

"Why didn't they listen?"

Let's start with the social psychology phenomenon known as the 'normalisation of deviance". In laypersons' terms, it describes a situation in which an unacceptable practice has gone on for so long without a serious problem or disaster that this deviant practice actually becomes the accepted way of doing things. As far back as 1979 (two years before the first shuttle launch and seven before the Challenger exploded), engineers warned of concerns with the O-Rings.

The Rogers Commission that investigated the Challenger explosion highlighted the history of concerns with the O-Rings that went back to 1979, and included a copy of a Morton Thiokol memo that indicated that the design would be best used for unmanned space travel.

In a 1979 Morton Thiokol memo, an engineer wrote that he believed the O-Ring rocket design should be used with unmanned rockets, as he was concerned about their failure. Burn-through and the resulting erosion of the O-Ring had been documented on several past flights. But in the absence of an explosion prior to the Challenger launch, NASA actually came to accept the failure of the O-Rings because no disaster had occurred.

The same social psychology phenomenon would rear its ugly head 17 years later at NASA. When a large piece of insulation struck the shuttle Columbia orbiter just after a 2003 launch, several NASA engineers expressed concern that a hole could have been opened in the shuttle wing.

NASA management dismissed the concern by saying that insulation had fallen off on multiple prior launches without harm to the shuttle occurring. A NASA engineer pleaded with his superiors to take a picture of the orbiting shuttle as he was concerned that the foam insulation that had hit the shuttle upon take-off had caused serious damage to the wing. His warnings were ignored, no picture or thermal imaging was performed on the Columbia orbiter during flight, and the ship disintegrated upon re-entry.

Impact to your company

Business leaders should take notice of the lessons learned from the two shuttle disasters. The normalisation of deviance is one of the most dangerous aspects of human nature in preventing disasters.

If an unexpected and undesirable event is taking place in your organisation, investigate and understand it thoroughly.

The absence of a disaster doesn't mean that one won't occur. Perhaps you've merely beaten the odds up till now, but statistics will catch up with you eventually, and the result could be tragic. If you find yourself or an employee explaining away known risks by saying, "we've done it this way before without problems", then your organisation may be succumbing to the normalisation of deviance.

This article first appeared in the SmartBrief on Leadership <http://bit.ly/1zG7qNe> on 24 October and was reproduced in the Engineers Australia journal in November 2014. *Dave Yarin is a compliance and risk management consultant to senior management and directors of large and mid-sized companies. <daveyarin.com>*

EARLY INTERVENTION FOR BLUE-GREEN ALGAE

Real-time monitoring for cyanobacteria.

The TriOS nanoFlu sensor is an online fluorescence sensor (fluorometer) used for the highly precise and selective measurement of coloured dissolved organic matter (CDOM, yellow substances), rhodamine, tryptophan and chlorophyll A in green algae or phycocyanin in cyanobacteria.

This fluorometer operates by emitting a UV light (LED) at a set wavelength targeted for specific waterborne flora and fauna. When present, these water constituents will re-emit light at a different wavelength following the excitation from the external light source. The nanoFlu monitors for the presence of, or change in, re-emitted light, which is calibrated to the concentration of the known organic matter.

Long-term stability of measurement is ensured by the combination of low power consumption, an innovative hydrophobic nano coating on the sensing window and chemical-free anti-fouling solution. Maintenance may also be reduced with the incorporation of pressured air cleaning of the sensing window, either from fixed, compressed air lines or the standalone TriOS AirShot accessory. Internal reference signals from the high-performance LEDs, used for fluorescence excitation, compensate ageing effects and temperature influences.

The submersible nanoFlu can be used in a diverse range of applications, including the real-time monitoring of:

- sea, river or freshwater reservoir systems
- incoming/outgoing flow at drinking and wastewater treatment plants
- potential filter membrane leaks during rhodamine testing.

In order to cover the wide range of possible monitoring applications that the nanoFlu can be deployed for, TriOS offers an extensive list of mounting alternatives, including inline fittings, flow cell (for example, water quality panels), small sensor floats (for example, plant-based monitoring) and unmanned buoys. As with the enviroFlu oil-in-water sensor, mobile laboratory staff can couple the nanoFlu with a TriOS Pocket Power G2. This not only provides battery power and wi-fi connectivity to the sensor, but also GPS logging for the instantaneous indication of possible algae bloom issues, with accurate geographical location data.

For more information about this or other products in the TriOS range of online analytical and environmental sensors, please contact Control Components on 02 9542 8977.

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WATER TREATMENT PLANT OPERATOR HELPER

Michael Fawcett

WIOA is always interested in useful information or tools to share with operational staff in the water industry. In 2014, I was fortunate to win the Kwatye Award for my idea to create an Application which could help operational staff to perform a variety of workplace calculations.

I have developed the "Water Treatment Plant Operator (WTPO) Helper" Application (App) for use with portable devices, such as smart phones, iPhones/ iPads and windows-based phones.

The WTPO Helper contains useful calculators for water operators and anyone in the water industry, including:

- Dam surveillance: seepage calculator
- Maintenance: pipeline flushing calculations, timers, volumes and travel times
- Water: chemical dosing, jar testing, pump drop tests and disinfection Ct calculations
- Wastewater: suspended and dissolved solids calculations.

In addition to the calculators, there are various tools and timers also available for operators to use:

- Water meter logging tool
- Plant data logging tool for recording pump drop test results
- Flushing timer and logging tool
- Dam seepage piezo data logging tool.

A favourites button allows the user to create quick links to specific calculators or tools used the most often.

The App is a FREE download through both the App Store (iPhone) and the Google Play store (Android).

After launching the App at the WIOA interest day in Marysville, a number of users have trialled the App on their mobile devices. They report that it was easy to download and install, the calculations are simple to use and the interface is straight forward and intuitive, even for the less tech-savvy.

For users who encounter any issues with the App, there is a Help button with links to contact me directly, or to access the Water Industry Communications Portal (WIACP) forums. I would also welcome feedback and suggestions on improvements to the App.

Figure 1. Screen shots of the App in action.

Figure 2. Michael Fawcett accepting his Kwatye prize at the 2014 WIOA Victorian Conference.

The Author

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Editor's Comment

As anyone with a mobile phone knows, Apps are proliferating at an incredible rate. There are already many Apps relating to Water Industry Operations. Do they all agree? Very unlikely. Before you use an App, it is important that you establish that the underlying theory used in the App is consistent with your Utility's operations and even check a few calculations manually yourself or with the help of senior operations staff before "just using them".

Alternatively, you can contact WIOAs Technical Operations Officer Dr Kathy Northcott, or Technical Adviser Dr Peter Mosse for advice.

THE SOLUTION TO SLUDGE-PUMP CHOKING PROBLEMS

The Lismore City Council was having chronic problems with its digester pump choking at the South Lismore Sewage Treatment Plant.

The pump would choke on a daily basis during its job of turning over the digester, according to Matt Potter and Brad Hampson at the plant. They were using a Gorman-Rupp T3A3S-B self-priming sewage pump, but the sheer number of rags made it very difficult for even this excellent solids-handling pump to pass all the rags, all the time.

Over the years, they tried different wear plates (even from different companies), but the best result they could achieve was to limit choking to once or twice a week by installing one of Gorman-Rupp's self-cleaning wear plates.

The council was then told of Gorman-Rupp's new Eradicator Solids Management System and wanted to try it. The Eradicator™ system features an aggressive self-cleaning wear-plate incorporating a number of notches and grooves, as well as a patent-pending lacerating tooth that helps break up stringy materials (such as rags), scrapes them off the impeller vanes and passes them through the pump – all without impacting performance or interrupting service. A special cover plate that comes with the system also includes a patented lightweight inspection cover that can easily be removed, if necessary, to inspect pump internals.

The Eradicator system is available on all Gorman-Rupp Super T Series pump models, so the range can achieve flows from five litres per second through to 150 litres per second and deliver heads to 40 metres, all while working on suction lifts to 7.6 metres. Because they are self-priming pumps, the pumps can be located at ground level, giving operators easy and safe access to the pumps for monitoring and/or service, unlike submersible pumps, which require cranes and several operators to access. And wet-well lids stay closed with self-priming pumps, meaning operators are not exposed to falling into the wet well when anything needs to be done with the pumps.

Clearance adjustments, oil changes, and general inspections only take minutes, which adds up to massive savings in time over the life of the pump.

Since the new system is available as an upgrade kit for existing Super T models, Lismore City Council installed one of these into its existing Gorman-Rupp T3. The pump then ran for three months without a single choke. In the same period, they would have expected to have between 12 and 24 chokes. Matt, Brad and their colleagues at the council were very pleased with the result.

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