WATER WORKS

TECHNICAL PUBLICATION OF THE WATER INDUSTRY OPERATORS ASSOCIATION OF AUSTRALIA

NOVEMBER 2020

ChemXpress is an Australian company supplying Chlorine Gas

Manufactured to the highest quality specifications together with the lowest moisture content

SAFETY

- Emergency Call Centre 1800 865 033
- Innovative approved drum & cylinder design enables quick capping of any valve leaks
- The ChemXpress Emergency Capping Kit is common to both drums and cylinders there is no need for 2 different kits
- Easy video instructions to install capping gear within seconds via App (available to view on or offline if remote)

OTHER SERVICES AVAILABLE FROM CHEMXPRESS

- AS WTP & WWTP Operator Training
- Assistance with MHF studies or applications
- AS2927:2001 Chlorine Installation Audits
- Lifting Beams AS4991-2004
- Capping Kits

FOR ALL TECHNICAL, PRODUCT OR SALES INQUIRIES PLEASE EMAIL **SALES@CHEMXPRESS.COM.AU** OR CALL **08 8947 6733**

WATERWORKS
OFFICIAL JOURNAL OF THE WATER INDUSTRY OPERATORS ASSOCIATION OF AUSTRALIA

Editorial Committee

Peter Mosse, Editor
peter.mosse@gmail.com

George Wall
george@wioa.org.au

Direct mail to:

Peter Mosse
WaterWorks Editor
c/o WIOA, 24 New Dookie Road
Shepparton, VIC 3630

EXECUTIVE MEDIA
NEW YORK | SYDNEY | MELBOURNE | ADELAIDE
EST 1972

Advertising & Production

Executive Media Pty Ltd
Level 6/185 Victoria Square
Adelaide, SA 5000
Tel: (08) 7425 1209
Email: adelaide@executivemedia.com.au
Web: www.executivemedia.com.au

WaterWorks is the technical publication of the Water Industry Operators Association of Australia (WIOA). It is published twice yearly. Neither WIOA nor the publisher assume responsibility for opinions or statements of facts expressed by contributors or advertisers.

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

CONTENTS

STAYING ENGAGED

When Prime Minister Scott Morrison announced in March 2020 that the COVID-19 pandemic could impact for as long as six months, this concept was a little hard to comprehend. Fast forward to October and the metropolitan area of Victoria is still in lockdown and the borders of many States are closed. His prediction has become reality.

The pandemic has forced Water Utilities to change how their operational teams are staffed and resourced to continue to deliver safe water and wastewater services to our communities on a daily basis. The pandemic has had a major impact on WIOA with all our face to face conferences and other events cancelled for 2020.

Many WIOA Corporate Members have also been impacted as they rely on the annual conferences to meet with the operators to showcase their products and services. Additionally, they have lost direct access to operators, with non-essential visitors locked out of treatment plants and depots around the country. Apart from losing the opportunity to interact with our Members, WIOA lost around 80% of our total revenue from the cancellation of conferences, events and training seminars. Following the event cancellations, we have needed to look for alternative income streams to stay afloat.

With encouragement and support from a number of Corporate Members, WIOA diversified into the online environment and offered Virtual Water – www.virtualwater.com.au as a substitute for the state conferences. Just on 50 of WIOA's Corporate Members generously supported this new concept of conference delivery. They willingly offered sponsorship and purchased Virtual Water expo booths to expose their products and services to the WIOA membership and broader water industry. The exhibition hall in the Virtual Water platform is available 24/7 and allows visitors access to all the information that businesses would normally like to share with the industry. The chat function allows company representatives to answer any queries or provide more information.

The support of WIOA's state based Advisory Committees and members has allowed an outstanding and diverse technical program to be offered on the 12 live days on the platform. An additional platform benefit is that the majority of the presentations are available for everyone to view in their own time from the 'on demand' section of the auditorium.

Virtual Water will be available online until mid-2021 and we would like to encourage all our Members to log in and have a look. We are sure you'll find useful presentations to watch and your support of our Corporate Members is vital. We hope that everyone has enjoyed and benefited from this 'new era' of conference and trade displays in Virtual Water and we are proud that WIOA has been able to continue to engage with members and provide the industry a platform to facilitate education and transfer of important operationally based information.

We look forward to being able to meet in person again, and we are planning a return to face to face conferences in 2021, subject to any COVID related restrictions and requirements. As the country comes out of lockdown in the coming months, we will monitor the situation and keep our members informed. We look forward to your support at our events, both online and when we get to meet again in person.

In 2014, WIOA was fortunate to host a seminar in Melbourne with world renowned Canadian water researcher Professor Emeritus, Dr Steve Hrudey. Dr Hrudey was the Keynote speaker on the first day of Virtual Water and his outstanding presentation can be viewed in the On-demand section in the Virtual Water auditorium. In 2014, Dr Hrudey provided us his 10 commandments for ensuring safe drinking water based on learnings from frontline experience with contamination events. We have reproduced the 10 commandments as the centre spread in this edition of WaterWorks as a reminder for all water treatment operators. Stay safe and well, and we hope to catch up with you all soon.

OUR COVER

South Gippsland Water operators Ryleigh Coombes and Dylan Angwin dosing algaecide from the bank at the Lance Creek reservoir.

EarthTec WEAKENS algae's DEFENCE layer, allowing the algae to be consumed by natural bacteria.

Even if circulation is not optimal, EarthTec self-disperses enabling large water bodies to be treated with LESS than 10 per cent of the traditional copper sulphate dosage.

Earth Science Labs Global is proud to announce it is now distributing a revolutionary algae and a scale control chemical technology across Australia, South East Asia and the Pacific.

contact@earthsciencelabs.global

www.earthsciencelabs.global

EARTH SCIENCE LABS GLOBAL

Positively impacting the world through revolutionary chemistry

ALGAECIDE MANAGEMENT OF BLUE GREEN ALGAE

Will Egan, Kerry Matthews and Bryan Chatelier

In November 2019, South Gippsland Water was exploring options to treat water catchments that have traditionally been affected by problematic cyanobacteria blooms, especially *Dolichospermum* and *Microcystis* species.

As part of this review, South Gippsland Water became aware of a new product that had been developed and used in the USA. On further investigation, Earthtec® appeared to be a good opportunity for South Gippsland Water to undertake a trial application throughout the 2019/20 algae season. This product was of interest to South Gippsland Water as it could substantially minimise OH&S risks and environmental impacts associated with the current use of copper sulphate pentahydrate. The product is produced by a proprietary process which yields almost 100% bioactive copper and is NSF/ANSI/CAN 60 certified for treating sources of drinking water.

As a result, South Gippsland Water elected to commence a trial at 3 reservoirs throughout the service area. A brief background of each reservoir selected to participate in the trial follows.

Lance Creek Reservoir: is a 4,200 ML earthen reservoir with a surface area of 800,000 m^2. To manage cyanobacterial blooms in this reservoir, the water treatment plant facility has several treatment options available including treatment with copper sulphate pentahydrate, powdered activated carbon (PAC) and blending with other water supply sources. Based on data over a 5-year period, when using PAC to manage taste and odour complaints, a typical dosage of 10–15 ppm has been applied.

Leongatha Reservoir No.4: is a 1,137 ML earthen reservoir with an approximate surface area of 160,000 m^2. Recently this reservoir has started to experience seasonal cyanobacterial blooms. South Gippsland Water has previously been treating this reservoir with copper sulphate pentahydrate. The application of copper sulphate pentahydrate powder has been delivered from a boat, relying on the agitation of the propeller to achieve mixing within the water body.

As rainbow trout are present in the reservoir, the treatment of algae has resulted in undesired fish kills.

Little Bass Reservoir: is an earthen reservoir with a capacity of 100 ML and a surface area of 45,000 m^2. The reservoir is currently out of service as this water system is now being supplied by the Lance Creek system. South Gippsland Water currently maintain a reasonable water quality within the storage as the reservoir is still open to the local angling club.

Trial Implementation

The product would first be trialled at Leongatha Reservoir No.4 and Little Bass Reservoir, as both were experiencing cyanobacterial algae blooms and were either offline or able to be taken out of service temporarily.

Trial 1: Leongatha Reservoir No.4

In January 2020, Leongatha Reservoir No. 4 was experiencing a *Dolichospermum c.f circinale* algal bloom. The reservoir was treated with EarthTec® on 21 January 2020. A dose of 480 L was applied, which, when targeting a depth of 1 metre across the surface area of 160,000 m^2 resulted in a dose of 3 mg/L.

For the trial, EarthTec® was delivered at 3 locations across the reservoir in approximate volumes proportionate to surface area. The application process involved 2 operators over a 1-hour period.

Table 1. Algal data for Leongatha Reservoir No.4 before and after dosing on 21 January 2020.

Date	Total Potentially Toxic BGA bio-volume (mm3/L)	Total BGA bio-volume (mm3/L)
13.1.20	14.1681	14.1688
21.1.20	63.335	63.34
28.1.20	0.12766	0.12785
3.2.20	0	0.00019
25.2.20	0	0.0194

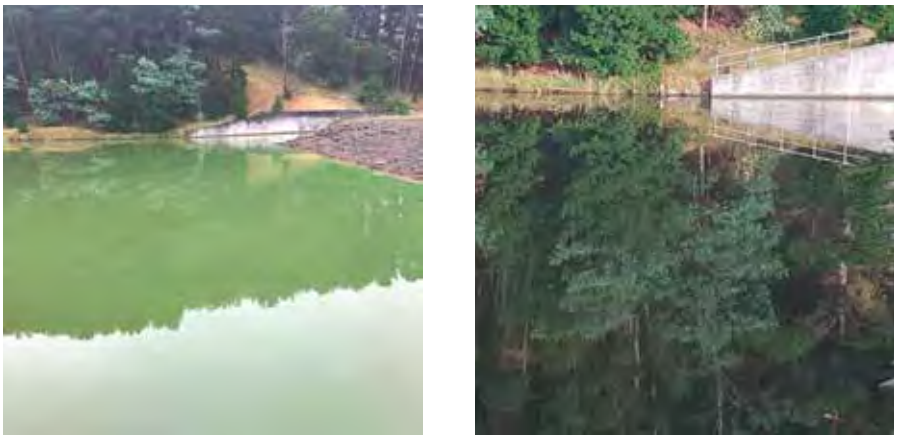


Figure 1a & b. Leongatha Reservoir No. 4 on the day of treatment (left) and 7 days after treatment (right).

The equivalent copper sulphate pentahydrate application would have normally taken four operators over a 4–6 hour period and would have required the management of significant OHS risks.

The blue-green algae bio-volumes of Leongatha before and after the EarthTec® treatment are provided in Table 1. Note that unless otherwise specified, all water quality analysis before, during and after the treatment was conducted by an independent NATA certified analytical laboratory. Where no result was obtained, 'NR' has been indicated.

The results show a decrease in blue-green algae bio-volume. Additionally, there was no evidence of any fish kills and, after 13 days, water from this reservoir was able to be sourced for treatment and supply.

The appearance of the reservoir before and after dosing is shown in Figure 1.

Trial 2: Little Bass Reservoir

In late February 2020, the Little Bass Reservoir was experiencing a *Dolichospermum-coiled (≥6um)* cyanobacterial bloom. This event provided South Gippsland Water with an additional opportunity to trial EarthTec®. As this reservoir was currently out of service, there was no water quality risk to the drinking water supply, however, the reservoir was still open to the local angling club and therefore there remained a need to maintain reasonable water quality. On 25 February 2020, the reservoir was dosed with 4 ppm of the product. To investigate the self-dispersing qualities of EarthTec®, the entire dose volume of 180 litres was applied from the reservoir embankment.

The algae bio-volumes from before and after the dosing application are provided in Table 2. A significant reduction in the blue-green algae bio-volumes was observed at Little Bass Reservoir. The majority of the bio-volume reduction took place within the first seven days after treatment.

The appearance of the Little Bass Reservoir before and after dosing is shown in Figure 2 (a & b).

Table 2. Algal data for Little Bass Reservoir before and after dosing on 25 January 2020.

Date	Total Potentially Toxic BGA bio-volume (mm3/L)	Total BGA bio-volume (mm3/L)	Total Copper Residual (ppm)
24.2.20	5.88236	5.88255	NR
3.3.20	0	0.00019	0.03

Figure 2a & b. Little Bass Reservoir on the day of treatment (left) and 7 days after treatment (right).

Trial 3: Lance Creek Reservoir

In March 2020, Lance Creek Reservoir was experiencing a *Microcystis* cyanobacterial bloom that was beginning to exceed South Gippsland Water's blue-green algae management procedure limits and consequently impact water operations. As Lance Creek had always been intended as the primary location to trial EarthTec®, and given the success with the previous two site trials, it was decided to complete a full reservoir dose.

Lance Creek Application No.1. The first dose was completed on 27 February. The reservoir was dosed with 1800 L of EarthTec®. This equated to a dose concentration of 2.3 mg/L of product to a depth of 1 metre across the surface area of the reservoir. The product was delivered to 4 locations within the reservoir, with the delivered volume proportional to the surface area. It was decided not to apply the entire dose volume in the one location and rely on the product self-dispersing, as the bloom needed to be controlled as soon as possible.

The water quality results for pre- and post-dose are shown in Table 3.

While a decrease in algae bio volume was evident immediately after the dose, by 5 March, the bio-volume numbers and the geosmin were already increasing again, suggesting that inadequate elemental copper had been applied to overcome the organic demand required to achieve an effective blue-green algae kill.

Table 3. Water quality results for Lance Creek Reservoir.

Date	Geosmin (ng/l)	Total Potentially Toxic BGA bio-volume (mm3/L)	Total BGA bio-volume (mm3/L)	Total Copper Residual (ppm)
24.2.20	3	125.7372	125.7590	0.016
27.2.20	5	NR	NR	0.021
2.3.20	2	0.5777	0.06018	0.025
5.3.20	7	1.23358	2.10843	0.022
10.3.20	5	1.89601	1.94424	0.024
12.3.20	5	4.39684	4.39703	0.024

Figure 3. Lance Creek Reservoir on 24 February prior to treatment with algaecide.

Lance Creek Application No.2.
Upon receiving the algae lab analysis on 12 March, it was confirmed that the initial application not been successful, as the blue-green algae bio-volumes had not reduced (Figure 4).

It was decided to trial a different application method. The trial approach was adopted to apply a volume of EarthTec® from the offtake only, that would treat approximately 300 ML of storage volume area around the offtake. The proposed theory was that the product may hold around the offtake and provide a zone of water that would come into contact with water being drawn into the offtake tower. It was also suggested that this method of application, if successful, may be a more cost effective option than treating the full reservoir.

On 13 March, 100L of algaecide was applied to the reservoir directly from the offtake tower. Unfortunately, this application quickly dispersed throughout the entire reservoir. While a slight reduction in blue-green algae bio-volumes was evident another full reservoir dose was required. This next dose was planned to occur on the week commencing 23 March.

The results from the 16 March dose are provided in Table 4.

Lance Creek Application No.3.
On 24 March 2020, South Gippsland Water applied a third dose of 3600 L to Lance Creek Reservoir. Using the previous dosing methodology of targeting only to a depth of 1 metre across the full reservoir surface area, an average concentration of 4.5 mg/L was applied. The product was dosed at 4 locations across the reservoir to aid the self-dispersing qualities.

Figure 4. Lance Creek Reservoir on 16 March 3 days after the second dose.

Table 4. Water quality results for Lance Creek Reservoir after the second application.

Date	Geosmin (ng/l)	Total Potentially Toxic BGA bio-volume (mm3/L)	Total BGA bio-volume (mm3/L)	Total Copper Residual (ppm)
16.3.20	9	3.47418	3.49602	0.008
23.3.20	4	0.64232	0.64314	0.016

Table 5. Water quality results for Lance Creek Reservoir after the second application.

Date	Geosmin (ng/l)	Total Potentially Toxic BGA bio-volume (mm3/L)	Total BGA bio-volume (mm3/L)	Total Copper Residual (ppm)
30.3.20	1	0.42702	0.43548	0.075
2.4.20	NR	0.00578	0.01877	NR
6.4.20	1	0.02607	0.03203	0.033
14.4.20	1	0.00158	0.00232	0.031
20.4.20	1	0.04366	0.0704	0.020

Figure 5a. Lance Creek Reservoir – 24.3.2020 – Day of application No.3.

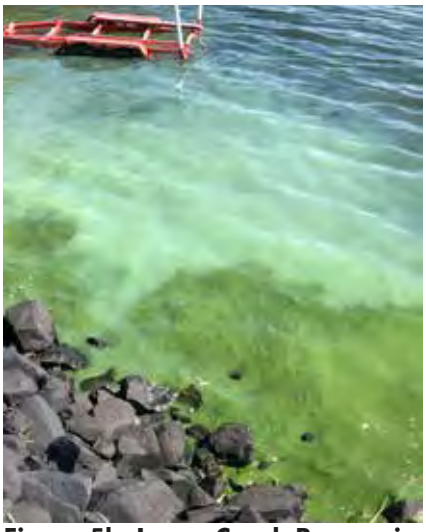


Figure 5b. Lance Creek Reservoir – 27.3.2020 – 3 days post dose No.3.

Figure 5c. Lance Creek 14 April.

The dose delivered on 24 March was the last dose applied to Lance Creek Reservoir. The post-dosing water quality results for the third application are provided in Table 5. The visual appearance of the reservoir is shown in Figure 5.

Conclusions to Date

Whilst this trial is still in an early phase, and data collection and monitoring is still occurring, the following observations have been made by South Gippsland Water.

Occupational Health and Safety

There appears to be reduced OHS risks normally associated with the application of copper sulphate pentahydrate powder. In particular, given the volume of copper sulphate pentahydrate powder required, manual handling issues during batching and the removal and exposure to dust are a major hazard associated with chemical in powdered form. It is worth noting that EarthTec® is a dangerous goods product, and therefore it does introduce risks to be managed with its use.

Environmental

Whilst EarthTec® and copper sulphate pentahydrate both add elemental copper to reservoirs, during these trials there has been significant reduction in the total amount of elemental copper added during each dose application to achieve the required blue-green algae reduction. At Lance Creek, previous doses have required approximately 1250 kg of elemental copper, while the most significant EarthTec® dose only added 250 kg of elemental copper to the reservoir. The neutral impact on aquatic life observed post EarthTec® applications has also been favorable.

Water Quality

Algal-related water quality data have indicated no unusual or unexpected results. At the Lance Creek Water Treatment Plant there has been a reduction in the PAC dose rate with the reduced blue-green algae numbers monitored. Additional time and the impact of seasonal factors will help determine whether the water quality benefits can be attributed to the use of EarthTec®.

As the initial trial observations have been encouraging, South Gippsland Water has elected to continue trialling EarthTec® as an algae treatment management option in 2020–21. The intention of the ongoing trials is to gain a better understanding of the operational costs, efficiency and suitability of the product given variations in seasonal conditions.

The Authors

Will Egan (wegan@sgwater.com.au) is a Water Treatment Technologist, **Kerry Matthews** a Water Resources Coordinator and Bryan Chatelier is the Water Quality and Treatment Manager, all at South Gippsland Water in southern Victoria.

FAILURE OF A SPIRAL LINED SEWER MAIN

Isaac Greene

In-situ lining technologies offer a low impact, low-cost method of rehabilitating sewer mains. Albury City Council has carried out a yearly rehabilitation program since 1982. Many mains have been rehabilitated during this time using a variety of different in-situ lining technologies.

Many of the original concrete and vitrified clay mains in Albury were installed in the early 1900s. Investigation of failures using closed-circuit television (CCTV) has found that the different pipe types have significantly different primary failure mechanisms.

Concrete typically fails in the crown of the pipe and exhibits a very brittle exposed aggregate look or significant cavities (Figure 1). Premature ageing of concrete sewer mains results from sulphuric acid attack. Sulphuric acid exists due to the presence of hydrogen sulphide gas which is a by-product of domestic sewage. Deterioration is further exacerbated if the sewer system does not have adequate ventilation (aerobic conditions).

In contrast, vitrified clay pipes typically fail due to stress fractures caused by poor firing in the manufacturing process (Figure 2) or from tree root ingress.

In August 2019, a significant sewer blockage occurred in the Albury CBD due to the failure of a spiral lined trunk main which had been relined in 1986 (Figure 3). The blockage resulted in a disruption to customers due to construction noise and road closures.

This was an unexpected failure as the Council's database had recorded the main as having been rehabilitated. It was also a failure mechanism, which had not been experienced by the Council before.

The blockage first appeared on Wednesday 21 August 2019, with the alarm being raised by the most upstream affected premises, the cinema. Upon investigation, the manhole was found to be at full capacity, requiring urgent attention. To prevent an overflow situation, a pump-around was set up and positioned over the top of a busy road. A special ramp was fabricated to allow the reopening of the road temporarily with reduced speed limits.

Figure 1. A typical failure of a concrete sewer main through acid attack.

Figure 2. A typical failure of a vitrified clay sewer main through stress fractures.

Figure 3. Pipe failure due to the unravelling of a spiral liner.

Initially, downstream manholes were investigated until it was observed that normal flow had resumed. This was discovered five manholes downstream of the blocked cinema manhole. Using CCTV, the cause of the blockage was determined to be due to the failure of a large section of spiral lining (Figures 4 and 5).

A works crew was sent to extract the lining. Manual extraction proved to be ineffective, so a second attempt was made by attaching the spiral lining to a truck-mounted jetter with a hydraulic reel. This method proved more effective, however the spiral lining was quite brittle, causing it to break at short intervals until finally the spiral lining was no longer accessible.

Eventually, the main required pipe bursting. Pipe bursting is the process of installing a new pipe through the existing pipe, which acts as the carrier pipe. This is done using a pneumatic bursting head with a reciprocating piston inside that creates a hammering action. It is this hammering action that breaks away the old pipe and allows the new pipe to be drawn through. In this scenario, for pipe bursting to be effective, the remaining spiral lining needed to be removed through multiple junction dig-ups. If the spiral lining was not removed, it had a tendency to concertina in front of the pipe bursting head, eliminating its ability to be drawn through the dilapidated carrier pipe and into the manhole.

Figure 4. The unravelled spiral lining blocking the sewer trunk main.

Figure 5. The spiral lining after removal from the sewer trunk main.

After successful rectification of this initial defect, normal sewer flow was observed to be only occurring in three manholes downstream of the cinema manhole. This indicated the presence of a second blockage. The main was initially jetted, resulting in the removal of a substantial amount of river gravel (which is a typical sign of a collapsed main).

Council's records showed that this main had been diverted in 1985 and was constructed from cast iron (Figure 6). As cast iron pipes seldom fail, further CCTV investigation was completed revealing that it was a concrete main which had collapsed only 0.5 m upstream of the manhole.

Pipe bursting was again used to rectify this defect, which involved excavating a launch pit directly behind the busy CBD premises. Upon excavation it was discovered that only the first 3 m was concrete, after which it returned to cast iron, as per initially recorded within Council's asset database. It appears that when the diversion was constructed, the existing concrete main was used as a stub to alleviate the need to break into the existing manhole. This remaining section of concrete had subsequently failed as a result of sulphuric acid attack over time (Figure 6).

Eventually, a new SN8 PVC pipe was installed through open excavation and the complete main in-situ relined returning normal flows. At this time, a total of eight weeks had passed, and traffic restrictions could finally be lifted.

Further Investigations and Key Learnings

The major blockages described raised questions about the integrity of 11 other spiral lined mains that had been installed in Albury in the 1980s. CCTV inspections of these mains revealed a further three defective mains existed, all of which stemmed from poor junction cut-outs.

An investigation into the integrity of the spiral lining also found it to be heavily discoloured and extremely brittle, suggesting that the asset had reached the end of its serviceable life.

Two of these mains were able to be rectified through fibreglass patching. This involved installing patches at the start, any intermediate junction and the end of the sewer pipe, followed by recutting of the junctions. The other main had significant unravelling of the spiral lining (Figure 7) that required pipe bursting.

Considering these findings, the Council is developing a sewer main asset risk assessment framework to guide future relining programs, including the selection of mains for rehabilitation. Each sewer main will be given a risk rating which considers age, material, number of connections, proximity to CBD, waterways (including the Murray River), schools, hospitals and the number of prior "chokes". This framework will then allow Council to prioritise the rehabilitation of the highest-risk sewer mains, mitigating future events like the one experienced in the CBD.

This event also highlighted the need to keep detailed and accurate records of previous work undertaken including the host pipe material type.

Future Work

The use of a junction liner installed within the existing spiral liner to reinforce poorly cut-out spiral lined junctions is currently being trialled (Figure 8). This is done by inserting an epoxy filled liner within the junction and expanding a bladder using compressed air until cured. This is expected to extend the life expectancy of spiral lined assets through reducing the likelihood of the spiral prematurely unravelling at poorly cut-out junctions.

Although pipe bursting can be used to rectify unwound spiral lines, limitations result from the need to remove the existing liner before pipe bursting can commence. This is required to prevent the tendency of spiral lining concertinaing in front of the pipe bursting head. Possible future improvements of pipe bursting technology should be investigated and may include a cutting blade which passes in front of the pipe bursting head to slice the spiral liner. A method such as this would significantly reduce the time to pipe burst spiral lined mains and increase the success rate of pipe bursting.

Another issue discovered was the internal diameter of the sewer main after spiral lining was not suitable to then also be in-situ relined using uPVC pipe. The use of ultraviolet (UV) cured lining technology as a more flexible alternative to uPVC lining is currently being assessed. UV liners are a fibreglass weaved tube impregnated with polyester resin and cured through the use of UV light. If this option proves successful, it will allow the complete spiral lined main to be relined, preventing premature unravelling.

The Author

Isaac Greene (igreene@alburycity.nsw.gov.au) is a Project Engineer with Albury City Council in NSW.

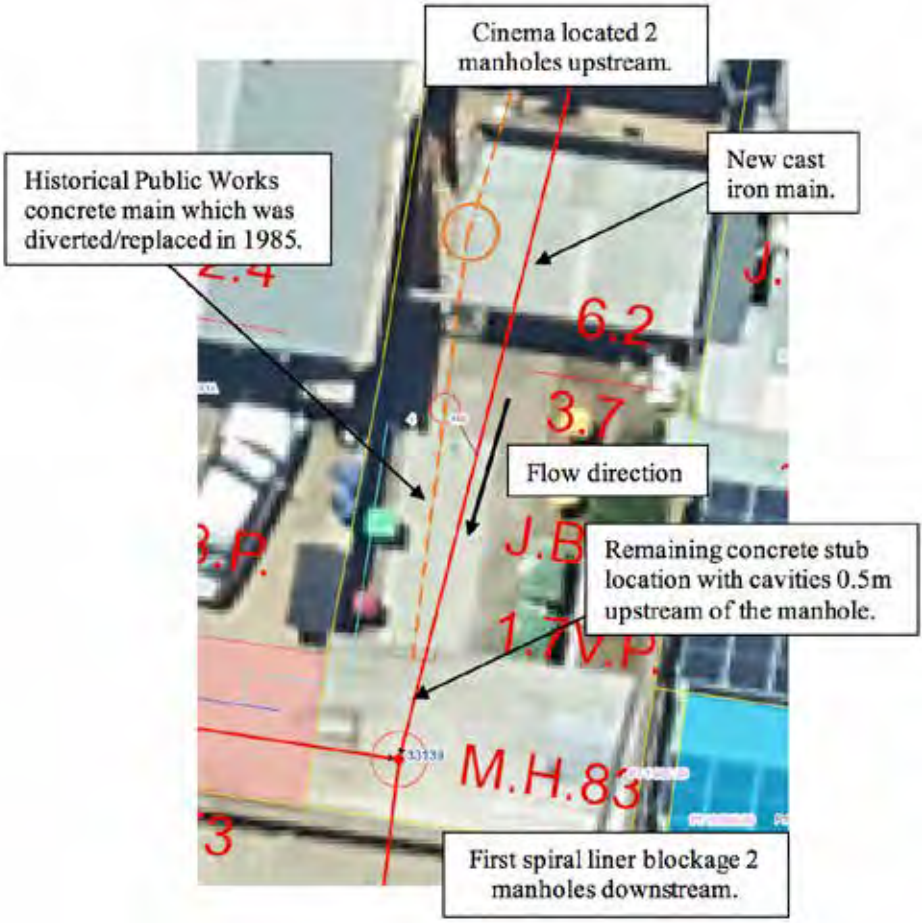


Figure 6. Sewer main diversion conducted in 1985.

Figure 7. View of an unravelled spiral junction.

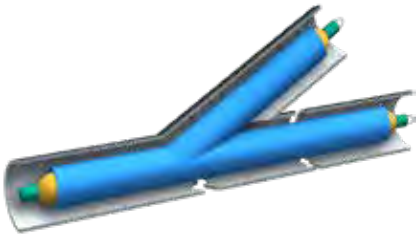


Figure 8. Typical junction liner (blue) currently being trialled to reinforce poorly cut-out spiral lined junctions. The expanding bladder is shown in yellow. ***(Diagram taken from SA Pipe Relining (2020), "The alternative solution to repairing your drains", viewed Tuesday 11 February 2020, https://sapiperelining.com.au/)***

bergmeier ENVIRONMENTAL

Bergmeier Environmental provide innovative and cost effective solutions to your sludge management and beneficial re-use projects in a safe and environmentally sustainable manner.

The Bergmeier family offer 30 years experience in the industry and have available the largest fleet of specialised dewatering equipment in Australia.

We service the following industry groups;

- Water
- Wastewater
- Food Manufacturing
- Abattoirs & Saleyards
- Coal & Mining
- Paper & Textiles
- Waste Processors

Services include;

- Dredging
- Dewatering
- Air Drying
- Bio Solids Management
- Centrifuging
- Transport
- Equipment Hire

Contact:
Ash Bergmeier – 0417 012 472
Dani Bergmeier – 0407 843 240
Ron Bergmeier – 0418 509 817

bergmeier ENVIRONMENTAL

BIOLOGICAL ACTIVATION OF FILTERS AT MILDURA WTP

Shahzad Sandhu and Kendall Niblett

Lower Murray Water operates two Water Treatment Plants (WTP) to supply water to Mildura. These are the Mildura WTP (MDA WTP) and the Mildura West WTP (MDA West WTP).

Historically, 83% of the water treated at MDA West has required PAC dosing while only 11% of the water treated at the MDA WTP required dosing with PAC. Normal practice was to put the MDA West plant offline for four months annually, leaving MDA WTP as the plant of choice only needing PAC dosing in times of algal blooms.

Comparison of data from the two plants revealed significant differences in the ability of the plants to remove the taste and odour compounds geosmin and MIB from the raw water in the absence of PAC dosing (Table 1). The results show limited capability of MDA West compared to MDA WTP to remove geosmin and MIB from the filtered water.

It was hypothesised that the backwashing of filters at MDA West with chlorinated water eliminated the bioactive biofilm on the filter media that was essential for the degradation of geosmin and MIB. To investigate this further, taste and odour complaints data was analysed in detail.

Figure 2 reveals that despite continuous PAC dosage, there had always been a higher probability of receiving a taste and odour complaint when MDA West was operational.

The reason for continuous PAC dosage at MDA West WTP was neither an operational nor a design issue. Filters were stipulated to be pre-chlorinated for occasional manganese (Mn) removal, but occurrences of high Mn in raw water were so rare that pre-chlorination was hardly ever used at the plant. However, turning off pre-chlorination proved to be inadequate while filters were still backwashed with chlorinated water.

Figure 1. Mildura West WTP.

Table 1. Geosmin & MIB levels (ng/l) without PAC dosing.

	Geosmin		MIB	
	MDA WTP	MDA West WTP	MDA WTP	MDA West WTP
Raw Water	4	4	56	9
Filtered Water	<1	4	2	8

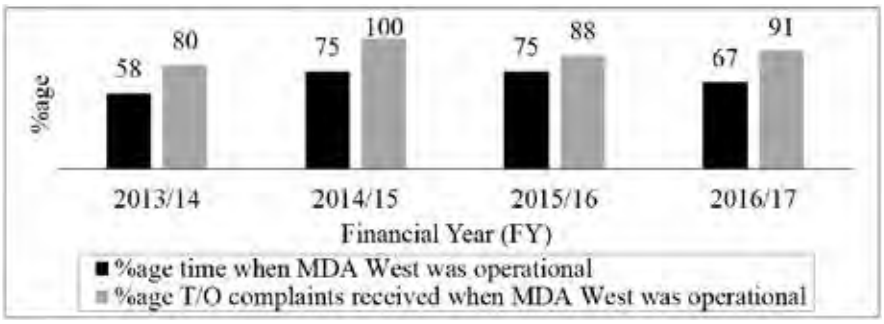


Figure 2. Comparison of taste and odour complaints received when the two different plants were operating.

Two options were considered to allow backwashing with chlorine-free water (Figure 3).

1. Storing and pumping the non-chlorinated filtered water for backwash
2. Dechlorinating the existing backwash line.

The simplest option was considered to be dechlorinating the existing backwash water as Option 1 had a large capital cost.

In August 2017, jar tests were performed to test the effectiveness of sodium metabisulfite (SMBS) for dechlorination. Increasing concentrations of SMBS were added to 1 litre treated water samples containing 1.0 mg/l residual chlorine. After SMBS addition, samples were stirred at 40 rpm for 22 seconds and at 100 rpm for another 6 seconds. The short time was chosen to reflect the conditions of the backwash water rinse. There is a very short contact time available between the dosing point to be used and the filter plenum entry point. In theory, 1.34 mg of sodium metabisulfite will remove 1.0 mg of free chlorine. In practice however, 3.0 mg of sodium metabisulfite is normally required to remove 1.0 mg of chlorine, which is exactly what was found in the jar tests. The reason for the higher than theoretical dose could be the short contact time or the presence of other chemicals in the water.

An inverse linear relationship between free chlorine residual and SMBS is shown in Figure 4.

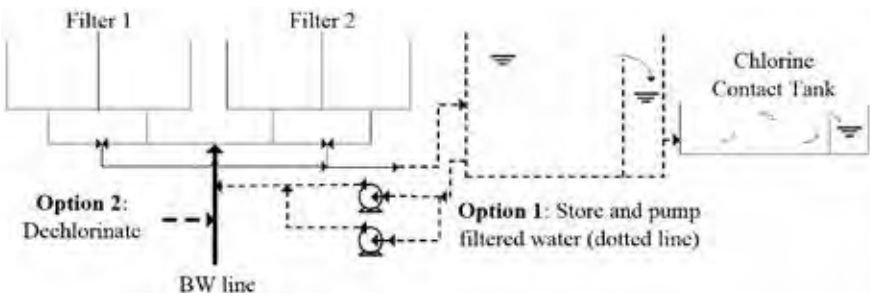


Figure 3. Options for backwashing without a chlorine residual.

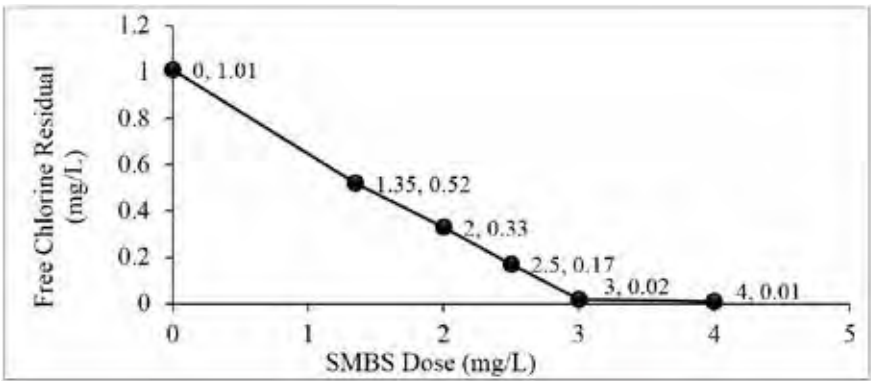


Figure 4. Results of the jar testing showing removal of free chlorine with increasing dose of SMBS.

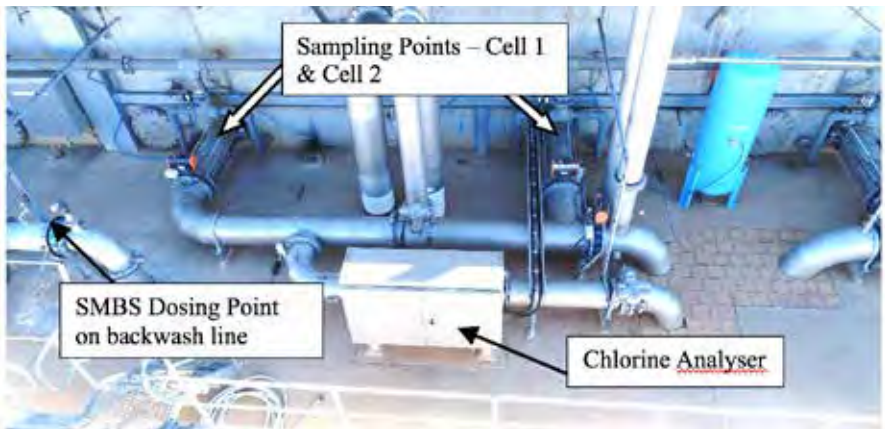


Figure 5. The trial dosing set-up for filter 1.

Use of SMBS

NSF/ANSI 60-2016 "Drinking Water Treatment Chemicals – Health Effects" sets a maximum dose of SMBS at 15 mg/L and sulfite residual levels in the finished water to remain below 0.1 mg/L. For dechlorination at Mildura West, the expected dose was ~3.0 mg/L, many times less than the allowed maximum dose. The sulfite levels were never expected to go near 0.1 mg/l as SMBS is added in backwash water and not the filtered water and the WTP has a "Filter to Waste" step at the end of the backwash sequence, which ensures cessation of SMBS dosing and resumption of filtration operation well before filters are brought back online (15–25 minutes).

Mildura West WTP was originally designed with the capability of dosing sulphuric acid for the treatment of saxitoxins but this system has never been required. It was decided to use the existing sulphuric acid area and dosing pump pipework which ran past the filter gallery for dosing SMBS. An unused urea dosing system at one of the wastewater treatment plants, which had a hopper and a batching tank, was disassembled and reassembled in position in the sulphuric acid dosing area. A spare chlorine analyser from another WTP was installed in the existing cabinet, dosing pumps were purchased new and the pipework was built from the suction point to the existing delivery point. The dosing setup is shown in Figure 5.

Optimisation of SMBS Dose

The lower the strength of the SMBS stock solution, the lower the shelf life. Shelf life is important as filter run times determine how long a batch would last. We currently run a batch strength of 25% giving us a few months for each batch. The SMBS is delivered in 25 kg bags.

The distance between the SMBS dosing points and dechlorinated water sampling points is short, providing contact time of only a few seconds. This has not proven to be an issue due to vigorous mixing achieved in the high-pressure backwash pipe.

The starting dose was set at 3.0 mg/L as determined by the jar test results but has progressively been reduced to 2.7 mg/L while maintaining full dechlorination. A typical backwash profile, where zero chlorine residuals are achieved is shown in Figure 6.

Based on the current dose rate, the cost for dechlorination of the backwash water is approximately $3 per backwash.

Outcomes

The results for geosmin and UV254 for the period from June 2018 through to January 2019 at both of the Mildura plants are shown in Figure 7, during which time there was no PAC dosing. Even though SMBS dechlorination operation started at the end of July 2018, there were periods when the SMBS dose was missed. Regular dechlorination started on 1 September 2018.

Both the raw and filtered geosmin results shown in Figure 7 are from MDA West. The UV removal is shown for both Mildura plants to show that they each removed a similar amount of UV but by October, when the filter biology was active, the geosmin removal ability was far more efficient, pretty much indicating the UV % removal was not an indicator of geosmin reduction.

The graph shows that UV254, a surrogate measure of dissolved organic carbon (DOC), was unchanged at each plant. However the ability to remove geosmin at MDA West was greatly increased after changing to the use of dechlorinated backwash water. Since October 2018, geosmin levels in the filtered water that had previously hovered in the range of 3-8 ng/l, dropped to 1 or <1 ng/L without any PAC dosing. It is worth noting that UV254, while a useful surrogate measure for DOC, is not a surrogate measure for geosmin in the results shown here.

The PAC dosing and reduction in geosmin levels was associated with reduced taste and odour of the filtered water. While Lower Murray Water does not receive a lot of taste and odour complaints, there has been some reduction in the number of formal complaints that supports the improved aesthetic quality of the water. Table 2 summarises the available data. Note that the 18/19 year is the year the SMBS dosing trial began.

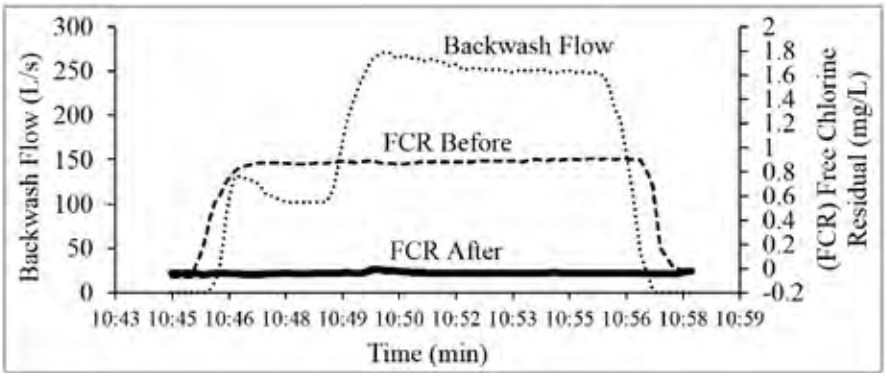


Figure 6. A typical backwash profile before and after dechlorination.

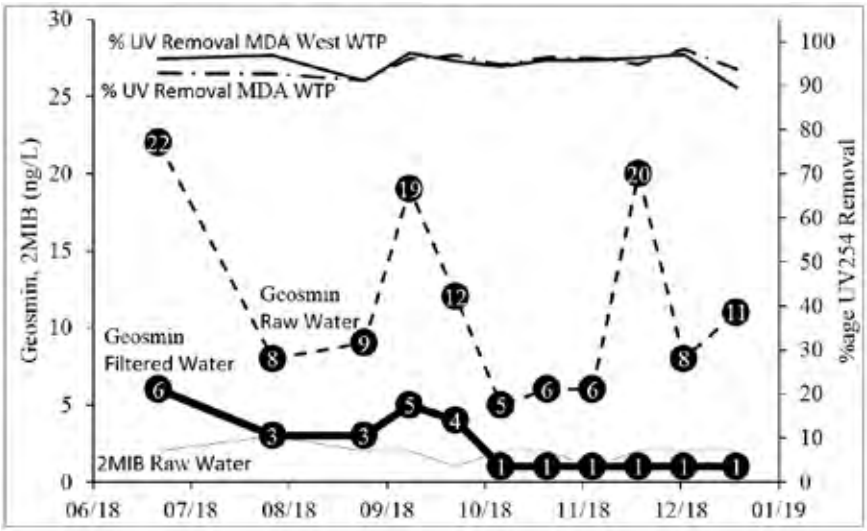


Figure 7. Geosmin removal without PAC dosing. Continuous SMBS dosing commenced on 1 September.

Table 2. Taste and odour complaints relating to the operation of the Mildura WTPs.

Year	Number of Complaints
16/17	23
17/18	10
18/19	9

There are three "suburbs" in Mildura. MDA West mainly supplies the Merbein area. Complaints there have dropped from 5 to 3 to zero over the same period.

While we all know having positive feedback on taste and odour rarely occurs, we did have water quality staff living in the area happily advising us the water is tasting better than previously.

To date, the data shows that SMBS can be reliably used to dechlorinate backwash water. While a missed SMBS dose does have some impact on the biologically active filter, it does not eliminate the biomass altogether. It would need a few successive backwashes to biologically deactivate filters.

Dechlorination of backwash water could potentially save Lower Murray Water approximately $50,000 annually in PAC costs for an outlay of only $1,500 for SMBS. It has eliminated the need for undertaking the capital-intensive project of more than $0.5 million for storing and pumping filtered water for backwash.

The Authors

Shahzad Sandhu (Shahzad.sandhu@lmw.vic.gov.au) is a Process Engineer and Kendall Niblett (kendall.niblett@lmw.vic.gov.au) is the Team Leader Operations with Lower Murray Water in Victoria.

RECYCLED WATER CONSUMPTION AT PORT MACQUARIE

Alan Butler

During the annual Running Festival held in Port Macquarie over the weekend of 9–10 March 2019, a recycled water incident occurred. As part of the event planning, the Port Macquarie–Hastings Council (PMHC) Major Event Team were asked to supply drinking water for participants from Council's "Choose Tap" portable drinking water stations (Figure 1).

The Running Festival came and went and was seen to have been a great success by all that were involved.

Ten days after the event on 19 March, the PMHC Water and Sewer Team were made aware that the three drinking water stations had been connected to the recycled water and not the potable water supply for the duration of the event. The fault was revealed during disconnection of the portable drinking water stations by Water and Sewer operational staff.

Port Macquarie is located on the Mid North Coast of New South Wales, about 400 kilometres north of Sydney. Council operates 5 water supply areas: Long Flat, Telegraph Point, Comboyne, Wauchope and the Bulk Water Supply for Port Macquarie, Bonny Hills, Camden Haven, Kew and Kendall. Council also operates an expanding recycled water network to provide a sustainable supply of recycled water for toilet flushing, laundry and outdoor use.

Currently Council operates a recycled water scheme supplying recycled water to connected commercial users and parks for irrigation. The treatment plant (Figure 2) is an ultrafiltration membrane plant with reverse osmosis, ultraviolet and sodium hypochlorite disinfection.

After being advised of the potential incorrect connection, council staff carried out an immediate check to ascertain where the filling stations were connected and to what water. Within 1 hour of the notification, it was determined that the connection had been to the recycled water system.

Council initiated their Incident & Emergency Response Protocols. An incident meeting was convened to determine the way forward and an immediate risk assessment was conducted. Given the high level of treatment and consistently high standard (including testing conducted on and off site) of the recycled water, it was believed unlikely that anyone who consumed this water would have noticed any adverse effects. There have been no detections of *E. coli* or coliforms at any of the sample locations within the recycled water system.

Open Communications

Council made it a priority to be open and transparent from the time of the initial notification. After the initial response team meeting, the event organisers were notified and briefed on the details of the incident. A request was made for a full list of all registered festival attendees so that direct communications could be made with every person prior to an official media release.

A briefing was also provided for all Water and Sewer and wider Council staff prior to the media release. Council expected there would be significant interest, many questions and media comments, and senior management wanted to ensure that staff were aware prior to the news breaking. A media release (Figure 3) was developed and issued via the usual media outlets.

Figure 1. A "Choose Tap" drinking water station.

Figure 2. The PMHC recycled water treatment plant.

Investigations and Findings

An immediate full-scale investigation was undertaken.

Where was the connection made?

The connection was made to a service connection that was in an underground recycled water meter box (Figure 4).

How did the connection get made?

A non-Council licenced plumber made the connection. The plumber was instructed to make the connection by a Council staff member but not by an authorised Water and Sewer Team member.

Was there adequate identification?

Yes, the meter in the pit was lilac, clearly identifying the type of water in the pipe, making it very hard to comprehend how the connection was made.

How much water was consumed?

The drinking stations contain an inbuilt flow meter that recorded 1500 litres of water was consumed during the event.

Was it actually recycled water?

Unfortunately yes, the connection was made to recycled water.

Could there be any other incorrect connections?

Council operates a dual reticulated water supply network throughout areas of Port Macquarie. This incident raised concerns that other incorrect connections could have been made, so checks were performed throughout the system. The recycled water is treated with RO, so little or no fluoride would be present in the recycled water, Testing for fluoride was a quick test that could be carried out to ensure that the water bubblers and filling stations were connected to the potable water supply.

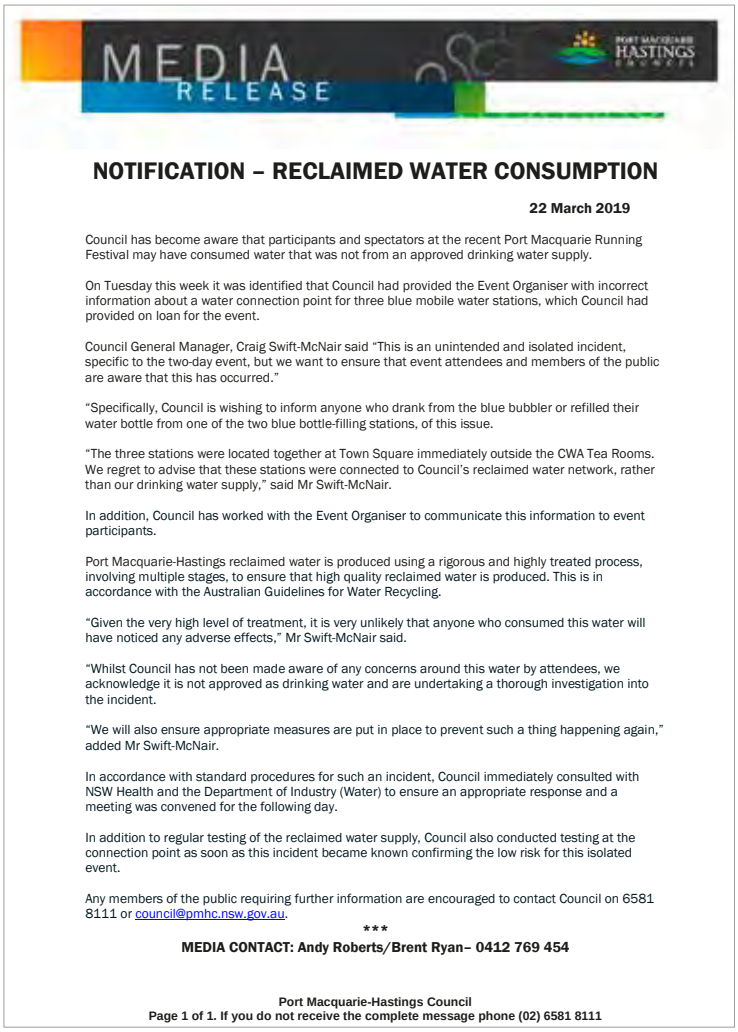
Ongoing Considerations

After the immediate actions were completed, Council considered the broader picture and what the consequences of the incident might have been or could still be.

- There could have been an adverse impact on public health.
- The Port Macquarie community may have lost confidence in the ability of Council to manage dual water supplies and possibly even Council's ability to provide safe drinking water in general.
- Promotors of possible future events might consider Port Macquarie to present too great a risk and look elsewhere.

The question for the future had to be: how to prevent a similar event happening again? Education has to be the basis of prevention. Council's internal and external education and awareness needed to be improved so that this type of incident won't happen again. Everyone needs to be aware that no-one is permitted to connect to the water or recycled water assets without the direct permission from a PMHC authorised Water and Sewer officer. Indeed, only Water and Sewer staff will install and connect water filling stations in the future.

Council also plans to conduct a thorough internal audit of all Management Systems and End User Agreements to ensure that the correct end-use controls are in place.



MEDIA RELEASE

PORT MACQUARIE HASTINGS COUNCIL

NOTIFICATION – RECLAIMED WATER CONSUMPTION

22 March 2019

Council has become aware that participants and spectators at the recent Port Macquarie Running Festival may have consumed water that was not from an approved drinking water supply.

On Tuesday this week it was identified that Council had provided the Event Organiser with incorrect information about a water connection point for three blue mobile water stations, which Council had provided on loan for the event.

Council General Manager, Craig Swift-McNair said "This is an unintended and isolated incident, specific to the two-day event, but we want to ensure that event attendees and members of the public are aware that this has occurred."

"Specifically, Council is wishing to inform anyone who drank from the blue bubbler or refilled their water bottle from one of the two blue bottle-filling stations, of this issue.

"The three stations were located together at Town Square immediately outside the CWA Tea Rooms. We regret to advise that these stations were connected to Council's reclaimed water network, rather than our drinking water supply," said Mr Swift-McNair.

In addition, Council has worked with the Event Organiser to communicate this information to event participants.

Port Macquarie-Hastings reclaimed water is produced using a rigorous and highly treated process, involving multiple stages, to ensure that high quality reclaimed water is produced. This is in accordance with the Australian Guidelines for Water Recycling.

"Given the very high level of treatment, it is very unlikely that anyone who consumed this water will have noticed any adverse effects," Mr Swift-McNair said.

"Whilst Council has not been made aware of any concerns around this water by attendees, we acknowledge it is not approved as drinking water and are undertaking a thorough investigation into the incident.

"We will also ensure appropriate measures are put in place to prevent such a thing happening again," added Mr Swift-McNair.

In accordance with standard procedures for such an incident, Council immediately consulted with NSW Health and the Department of Industry (Water) to ensure an appropriate response and a meeting was convened for the following day.

In addition to regular testing of the reclaimed water supply, Council also conducted testing at the connection point as soon as this incident became known confirming the low risk for this isolated event.

Any members of the public requiring further information are encouraged to contact Council on 6581 8111 or council@pmhc.nsw.gov.au.

***

MEDIA CONTACT: Andy Roberts/Brent Ryan– 0412 769 454

Port Macquarie-Hastings Council
Page 1 of 1. If you do not receive the complete message phone (02) 6581 8111

Figure 3. The media release.

The Author

Alan Butler (alan.butler@pmhc.nsw.gov.au) is a Water & Sewer Process Engineer with Port Macquarie Hastings Council in New South Wales.

Editor's Note

Full credit to Port Macquarie Hastings Council for publishing this account. All too often incidents like the one described here are kept "in house" thereby preventing others in our industry the opportunity to learn from all errors, no matter where they occur.

Figure 4. An underground meter box showing the connection point.

10 Comma
for Safe Dri

Steve E. Hrudey & Eliz

Ensuring Safe Drinking Water - Learning from Frontline Experi

1 Never say never!

Contamination can strike any system. The test for you will be how quickly you recognize trouble and deal with it effectively.

2 Do not underestimate the capacity of faecal (human or animal) waste to make water unsafe.

Ample evidence proves how remarkably little faecal waste is needed to seriously contaminate drinking water.

3 Learn from experience - do not just survive it.

Learn from your mistakes and from those around you.

4 Make sure you understand why you must comply with regulated requirements.

If you only do things because you are told to, you are well on your way to complacency and worse to come.

5 Recognize when you do not understand what is happening.

Admit it and seek help to understand.

6 Treat water operations like defensive driving.

Expect mistakes by others.

ANDMENTS
NKING WATER

ABETH J. HRUDEY. 2014.
ENCE WITH CONTAMINATION. © AMERICAN WATER WORKS ASSOCIATION.

7 DO NOT OVERLOOK THE OBVIOUS.

If your plant is so poorly maintained or filthy that a reasonable person would not consider eating food there, you should not expect a rational person to have confidence in your ability to produce safe drinking water there.

8 MAINTAIN HEALTHY SKEPTICISM ABOUT THE FIRST EXPLANATIONS OF WHAT IS WRONG.

If things are going seriously wrong, an unfortunate coincidence involving independent but noncritical problems may lead your corrective efforts astray.

9 DO NOT LET OTHERS (MANAGERS, POLITICIANS) BE ABLE TO PIN THE BLAME ON YOU.

If you know that improvements are needed, document those needs in detail and bring them to the attention of your immediate supervisor.

10 TAKE PRIDE IN THE PUBLIC HEALTH RESPONSIBILITY THAT YOU CARRY AND MAINTAIN.

Our society generally takes drinking water for granted, but you must recognize and make sure your family and friends understand that all those involved in ensuring delivery of safe drinking water are in the front line of protecting public health.

STATISTICAL PROCESS CONTROL FOR IMPROVED WATER QUALITY

David Bartley

Most Water Utilities use some form of control chart to monitor their drinking water and treated sewage quality. These control charts help operators keep their treatment processes in control and typically consist of critical limits and control or adjustment limits, as shown in Figure 1.

Control limits provide early warning to operators that the parameter is trending unfavourably and heading "out of control". This gives the operator time to take corrective action(s) to prevent a breach of the critical limit and keep the process "in control".

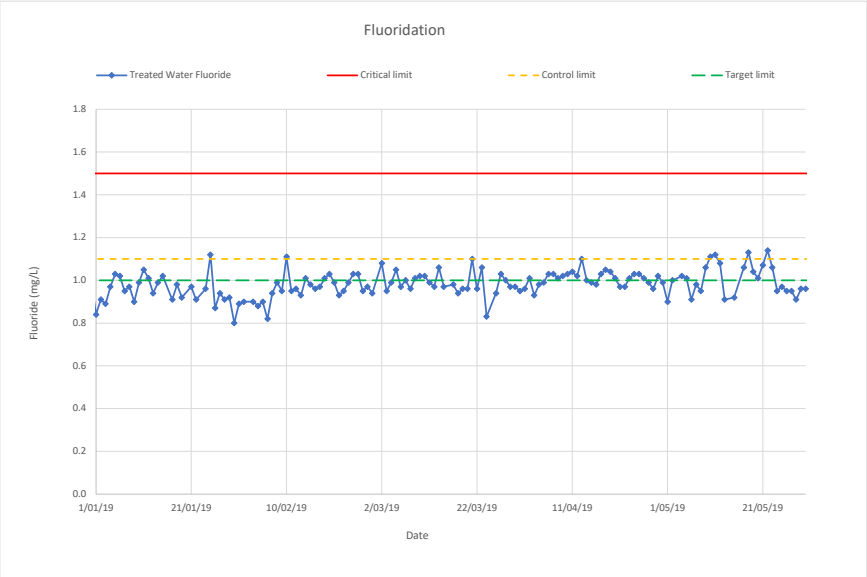


Figure 1. A typical water quality control chart. (Note that the same coloured lines for the critical limit and control limit are used in the following graphs as well.)

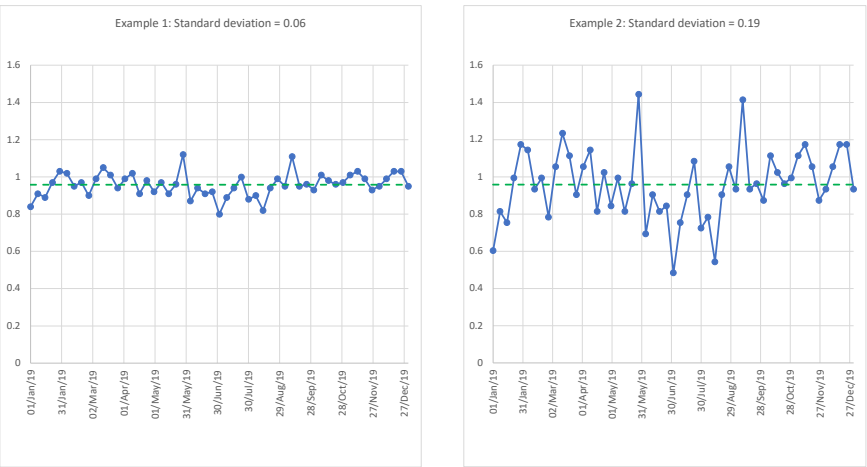


Figure 2. Examples of the standard deviation for data sets with the same mean but with different variability as shown by the standard deviation of 0.06 for Example 1 and 0.19 for Example 2.

Control limits are often set arbitrarily based on operational experience at a particular plant. Similarly, they are often set without full consideration of the performance of the overall plant and possibilities for improvement of that performance. This ad hoc method of setting control limits can cause problems.

If control limits are too close, most of the data will be outside the limits causing annoyance for the operator, particularly if alarms are linked to the control limits, and confusion as to which incidents require further investigation.

If control limits are too wide, by the time they are reached, there may be insufficient time for operators to take action to prevent breach of the critical limits.

Setting arbitrary control limits does not allow for changes in process performance over time due to seasonal impacts or improved operation.

Statistical Process Control

Statistical process control began in the manufacturing industry in the 1950s. The use of control charts with statistical control limits was based on the theory that 99.999666% of a set of data will fall within 3 standard deviations either side of the mean or average. This approach allowed industries such as car manufacturing to reduce the variability in their processes and therefore reduce the amount of component reject.

The standard deviation is simply a number that relates to how much variation there is in the parameter that is being measured. It is therefore a measure of how "in control" the parameter is. If the standard deviation is low, all the data is in control. If the standard deviation is higher, the data is less in control. Figure 2 shows the standard deviation for 2 sets of data with the same mean but with Example 2 less in control than Example 1.

What Happens if the Control Limits Are Too Wide?

When control limits are set too far from the mean, there is a risk that an unfavourable trend of instability may not be noticed until it is too late to prevent breach or high maintenance costs.

An example of data from a recycled water plant where the reverse osmosis (RO) electrical conductivity continued to rise to 4 times the average without reaching the upper control limit is shown in Figure 3. Once the operators noticed the trend, the membranes were replaced and the conductivity returned to normal.

The same electrical conductivity data provided in Figure 3 with the control limit changed to 3 standard deviations above the mean for the period from July to October 2018 is shown in Figure 4. With this statistical control limit, the rising trend could have been noticed nearly a year earlier and potentially membrane cleaning could have extended the life of the membranes and saved the cost of replacing the membranes.

What Happens if the Control Limits Are Too Narrow?

If the control limits are set too close to the mean, there can be so much data outside the limits that it is not possible for the operators to determine which events to investigate. This can result in unfavourable trends or instability going unnoticed. It can also result in the operators losing confidence in the control charts as a tool for improving plant performance.

An example of recycled water free chlorine residual where the upper control limit is so low that nearly all the data is above that limit is shown in Figure 5.

Alarm limits are also often set based on the control limits. This is a very good practice. However, with the control limits set too narrow, the alarms will activate continually and "drive the operator(s) mad". What usually happens then is that the alarms are deactivated or the alarm limit adjusted way too high, or too low to prevent triggering of the alarm. This then increases the risk of producing unsafe drinking water from a WTP or out of specification effluent from an STP. The control limits and alarm limits need to be set "just right".

The same data shown in Figure 5, with the upper limit adjusted to 3 standard deviations above the mean is shown in Figure 6.

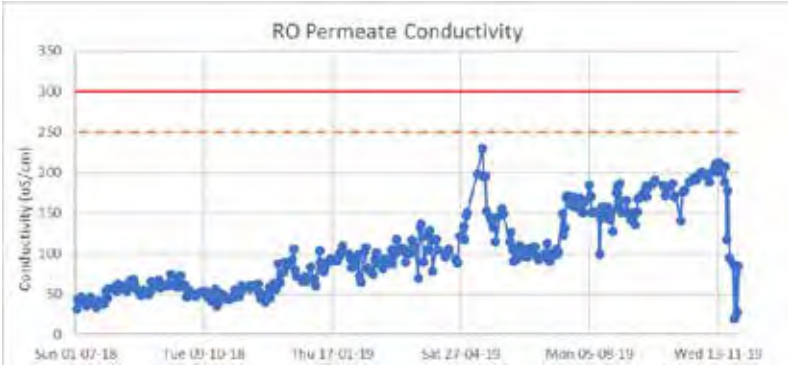


Figure 3. Example of a control chart with the control limits too wide. The orange dashed line is the control limit and the red line the critical limit.

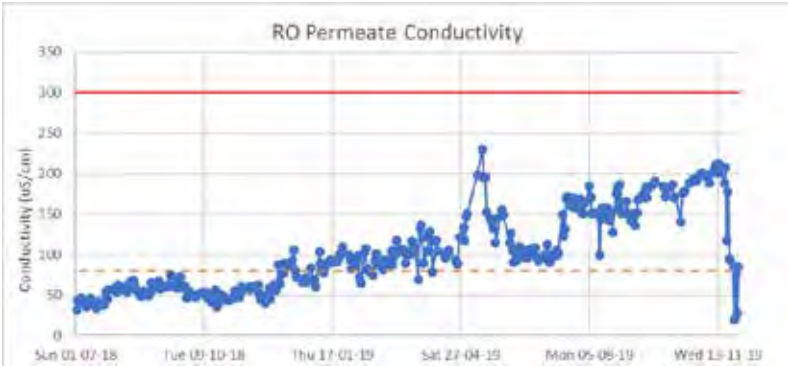


Figure 4. The same control chart as Figure 3 with the control limit adjusted to three standard deviations from mean. The orange dashed line is the control limit and the red line the critical limit.

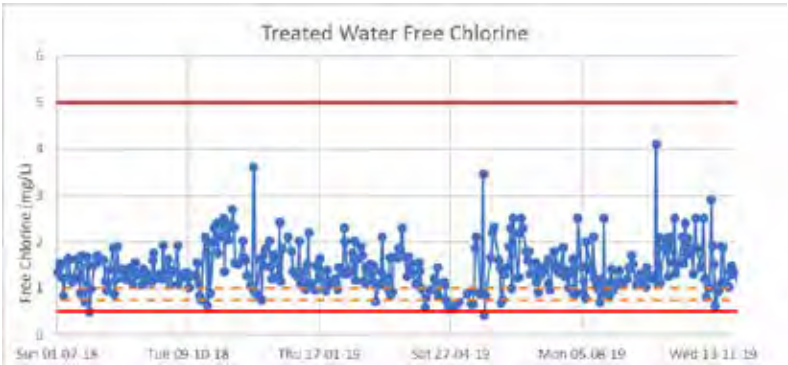


Figure 5. An example of a control chart with the control limit set too narrow. The orange dashed lines are the upper and lower control limit and the red lines the upper and lower critical limits.

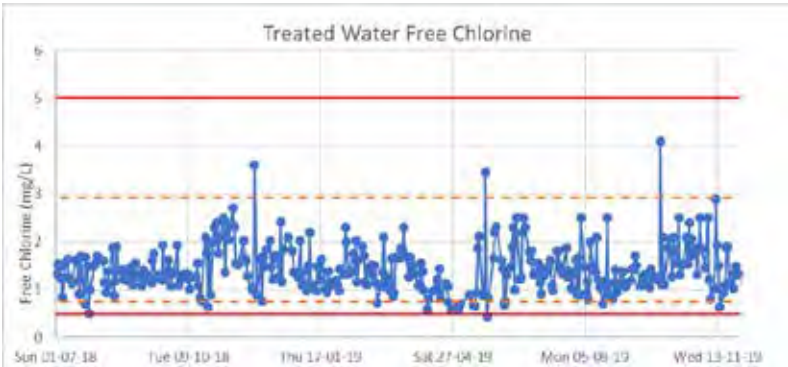


Figure 6. The same data in Figure 5 with the upper control limit adjusted to three standard deviations above the mean. Orange dashed lines are the upper and lower control limit and red lines the upper and lower critical limits.

This control chart now directs the operator to focus investigation on the highest peaks that are closest to the critical limit.

Continuous Improvement

By using the standard deviation calculated from the latest data, the control limits will automatically adjust as the performance of the process changes. Depending on the frequency of data collection and the rate of change, the mean and standard deviation should typically be based on the last one to three months.

If we look at the previous example of recycled water free chlorine and remove the peaks above the upper control limit, the limit drops from 2.9 mg/L to 2.5 mg/L automatically as the process becomes more in control (Figure 7).

This automatic adjustment allows operators to focus on the most important data that will improve the reliability of their processes and contribute to improved water quality outcomes over time.

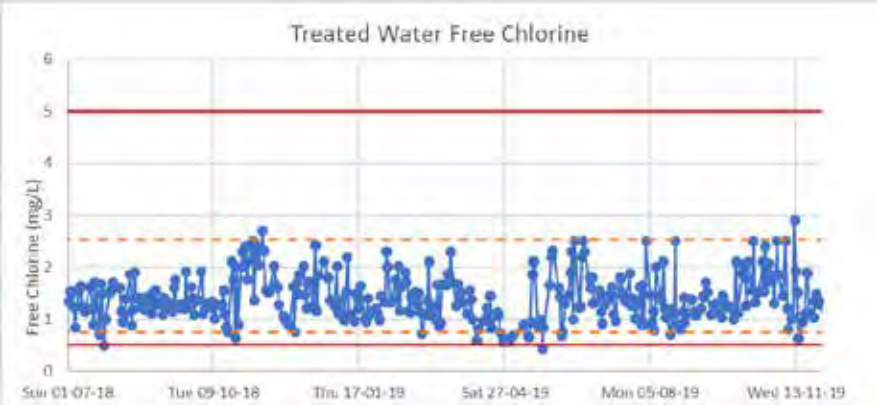


Figure 7. Automatic lowering of upper control limit as the high (spike) values are removed. The orange dashed lines are the upper and lower control limit and the red lines the upper and lower critical limits.

By setting control limits using simple statistical methods, unfavourable trends and unstable control are clearly identified allowing operators to focus on the problems that are most important. The statistical control limits will also automatically adjust as the process changes thereby ensuring operators are able to achieve continuous improvement in their water or effluent quality.

The Author

David Bartley (david@atomconsulting.com.au) is the Operations Support Manager with Atom Consulting.

KARI DOES LEVEL BEST

KARI FLOAT SWITCHES

Reliable pump and valve control delivers flexible level solutions:

No More Tangles

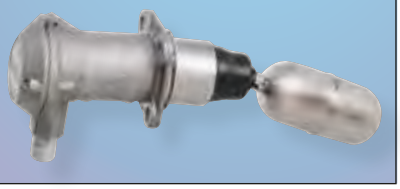
- No more tangles – up to four switches in one float
- Choice of three different sized floats to ensure enough buoyancy for your application – ranging from clean to black water.
- Wide range of output configurations: high / low level alarm, pump control & gold plated contacts for low voltage / current applications (e.g. battery powered telemetry systems).
- Perfect for sumps, sewage, water & wastewater treatment, power stations & silo (solids) monitoring

---

TRIMOD BESTA FLOAT SWITCHES

Rugged SS switches – Ex, low current, top mount & pneumatic alternatives

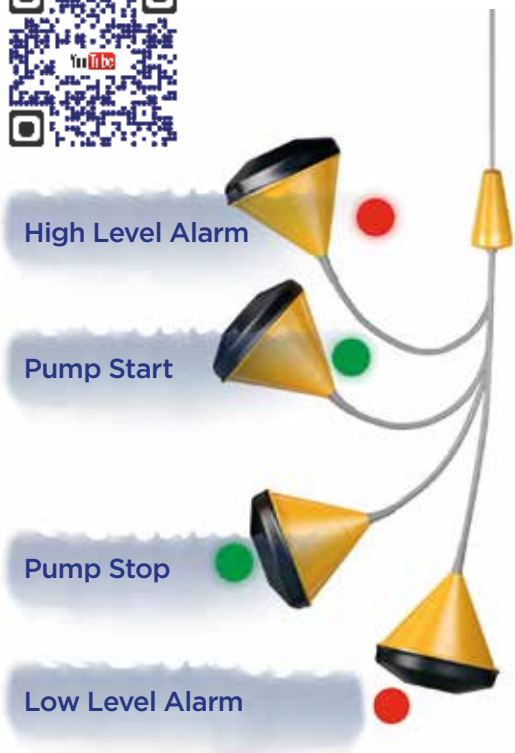
BESTA



WEKA MAGNETIC VISUAL LEVEL INDICATORS

- *Locally made*
- *+GF+ PVC and PVDF*
- *316SS*
- *Scales and level alarms.*

WEKA®



Emptying control + high level alarm
The pump is switched on when the liquid level rises to the pre-determined high point and remains on until the low level has been reached again. The switch also issues both low and high level alarms.

CCEZY.COM.AU +61 2 9542 8977

Distributors through Australia and New Zealand

WE'VE GOT YOUR...

Control Components

SAFER PUMP REMOVAL AT LOGAN CITY

Anthony Domanti and Scott Smith

The Alfred Street SPS69 wastewater pump station is the largest in Logan City, servicing 200,000 people in the Loganholme Wastewater Treatment Plant catchment. The site contains two separate pump stations, the original SPS02 pump station and the newer SPS69 pump station. The SPS69 pump station is a submersible pump-type station with an 8.5 m diameter, 22 m deep wet well (Figure 1). The station is fitted with three 375 kW submersible pumps, each with a capacity of approximately 1,000 L/s. The pumps weigh approximately 5 tonnes each and are over 3 m high (Figure 2).

Removing the pumps from SPS69 has been an extremely high risk and labour intensive activity requiring full confined space entry and parallel crane operations. A complete breakdown of resources required for the pump removal is listed below:

- 10-tonne overhead bridge crane to remove/refit the pumps.
- 2-tonne overhead bridge crane to lower a person into the wet well to connect the pump to the 10-tonne crane.
- Mobile crane truck required in case of rescue.
- 6 personnel including
  - 3 crane operators
  - 1 person to supervise confined space entry
  - 1 person to be lowered into the wet well
  - 1 person to assist around the site.
- A "man cage" to carry personnel and equipment.

These requirements were a major issue for operations and maintenance staff. Maintenance personnel were lowered into the wet well via a "man cage" using the 2-tonne crane. The 10-tonne crane hook was lowered to the person in the well to manually engage the lifting point on the top of the pump (Figure 3).

Figure 1. Looking down into the SPS69 wet well.

Figure 3. The longstanding procedure for removing pumps relied on two bridge cranes, a man cage (left) and confined space entry into the wet well to shackle the pump. The right photograph is taken looking down into the wet well when the pump was being shackled.

Figure 2. The existing SPS69 pumps weigh approximately 5 tonnes and are over 3 metres high.

The pumps require servicing every 6 months and when any breakdowns occur. Pump servicing takes approximately 8 hours to complete at a labour cost to Council of approximately $4,080.

It was not considered a prudent practice to continue with this method in the longer-term. The height restriction associated with using the existing crane hook and the unsuitable lifting bail arrangement on the pumps did not enable a proprietary "deep-lift" pump removal system to be used for this application.

During the planning phase of the most recent Alfred Street pump station upgrade project, numerous discussions, workshops and site investigations were undertaken to resolve the pump lifting issue. An option to raise the crane hook height by raising the existing superstructure and procurement of a propriety lifting device were discarded. This was due to the high cost and the inability to commercially retrofit the existing pump with a suitable lifting bail for a deep-lift system.

Design, Construction and Commissioning of a New Lifting Device

Specialist lifting organisations Stenhouse Lifting and RUD Australia were approached to design and supply a lifting solution for the pump station. The agreed scope of work for the project involved the design of a new pump lifting point, and a lifting device that would operate when submerged in wastewater.

The key features of the pump lifter design included a self-latching hook, remote release mechanism, balancing counter-weight and axially adjustable guide for activation during the lift.

The self-latching hook and remote release mechanism eliminates the need for personnel to enter a confined space for hook engagement and disengagement.

Figure 4. 3D modelling (left) and finite element modelling (right) were used during the design of the pump lifter.

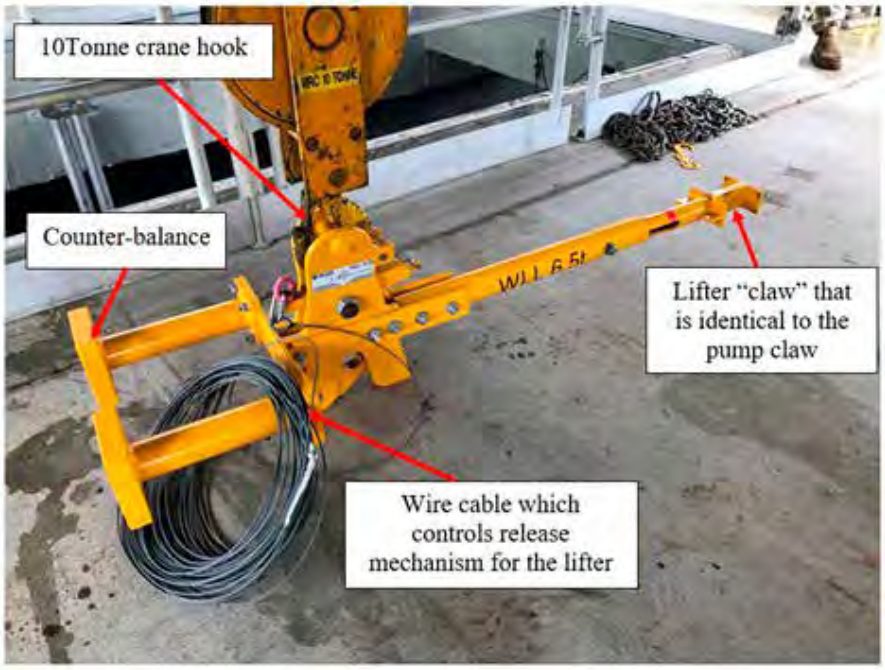


Figure 5. Components of the lifter.

The axial adjustment allows for a shift in the centre of mass during the lift and management of any minor misalignment of guide rails. The counter weight at the opposite end of the guide mechanism helps to balance the lifting device when used without the pump.

The lifting device was designed and manufactured in accordance with Australian Standards AS 4991-2004 Lifting Devices and AS 3990-1993 Mechanical Equipment – Steelwork. The lifting device was rated with a Working Load Limit of 6.5 tonnes.

Prior to construction, three-dimensional and finite element modelling were used to design key components of the lifting equipment and predict the behaviour of the product in real-life conditions (Figure 4).

The tare mass of the lifting device was also optimised using CAD software prior to manufacture. The final weight of the lifter is approximately 150 kg. The device and the lifting point were proof load tested to twice the Working Load Limit as per AS 4991-2004 requirements. The key components of the lifter are shown in Figures 4 and 5.

Pump Lifting

Only two staff are now required; one person to operate the 10-tonne crane and a second person to provide "slack" to the wire cable which opens the release mechanism on the lifter.

The 10-tonne crane hook is engaged on the lifter and is lowered down onto the pump's guide rails. The lifter claw allows the lifter to slide down the pump guide rails (Figure 4 left hand photograph and Figure 6). The hook of the lifter has a spring-loaded latching mechanism (Figure 4) that automatically engages when it finds the lifting bail located on the pump (Figure 6).

Once the 10-tonne crane cable shows sign of slack, this indicates that the lifter has been engaged onto the pump and indicates to the operator that the crane is able to lift the pump.

Pulling on the wire cable which opens up the latching mechanism disengages the lifter away from the pump. The lifter can then be removed. As an additional visual aid, the crane operator has a load display available on the crane which enables the operator to determine what load is being seen by the crane.

Costs

The design, manufacture and commissioning of the lifting device cost approximately $40,000.

Operational costs have been considerably reduced mainly because the number of required personnel has been reduced from six to two.

In addition to financial savings, there have been a number of other benefits.

- Operator safety has been significantly improved by eliminating confined space entry and working at heights requirements.
- The lifting device has eliminated the need for high risk lifts using multiple cranes and has reduced the labour requirement.
- The lifting device can retrieve the pumps under wastewater if required.
- The lifting design concept can be applied to other pump stations.
- The lifting device is significantly more compact (a quarter of the height) than other proprietary deep-lift systems.

Figure 6. Close-up view showing how the lifter engages onto the pump.

Authors

Anthony Domanti (anthonydomanti@logan.qld.gov.au) is a Project Development Manager with WSP and Logan City Council's Logan Water Partnership, and Scott Smith (scottsmith@logan.qld.gov.au) is a Mechanical Maintenance Supervisor with Logan City Council.

WTW

a xylem brand

WE DO MORE WITH LESS. LOW REAGENT USE AND HIGHER EFFICIENCY.

The new Alyza IQ series from WTW adds innovative wet chemistry analyzers to the IQ Sensor Net range of dependable online monitoring instruments for water and wastewater.

Alyza IQ Orthophosphate and Ammonium analysers provide you with lower reagent use than most other units, along with simple servicing, highly accurate measurements, and automatic self-calibration. All up, you get testing you can count on, that also delivers a great Return On Investment.

Why choose Alyza IQ?

- Less than 1ml a day reagent use (P04), and just over 2ml a day (NH4), for typical low-range use.
- Clever sealed reagent bag design makes replacing reagents easier and safer, than ever before.
- Real-time monitoring of reagent levels helps keep your analyzer operating efficiently.
- Routine self-calibration ensures you get consistently accurate measurements.

Contact us for more information.

13 19 14 | xylem.com/au

xylem
Let's Solve Water

WAGO PRO 2 POWER SUPPLY

POWER COMMUNICATES NOW!

With the Pro 2 Power Supply, WAGO offers a new solution that satisfies all the requirements of modern mechanical engineering.

Our answer to the increased requirements in the control cabinet industry is the WAGO Power Supply Pro 2. The very high efficiency of up to 96.3% enables a particularly slim design and the associated space savings in the control cabinet as well as resource-saving energy use with high savings potential in terms of costs and CO^2 Emission.

The WAGO PRO 2 Power Supply attachable communication modules enable permanent fieldbus communication, e.g. via IO-Link, Modbus RTU and ETHENET-based protocols. This allows data such as current and voltage values, temperature, overload behavior and operating hours to be read out. In addition, the power supply can be configured remotely and thus adapting to the requirements of the system. Parameters such as output voltage, load or overload behavior, signaling, etc. can also be set.

Class-Leading Features of the WAGO PRO 2 Power Supply

- **The efficiency champion:** Efficiency up to 96.3% saves money and resources.
- **Pioneering communication:** The snap-on type communication module allows continuous fieldbus communication while updating you on all status information and data.
- **Suitable for nearly any application:** Many different Pro 2 parameters can easily and quickly adapt to suit your needs via software.
- **Intelligent load management:** TopBoost or PowerBoost provides sufficient output current at all times.

sales.anz@wago.com | (03) 8791 6300 | www.wago.com.au

BIO-AUGMENTATION AT ATHERTON WWTP

Anthony Ruge and Scott Buckley

The Atherton Wastewater Treatment Plant (WWTP) in Far North Queensland processes approximately 1.8 to 2.0 ML of wastewater per day, with flows increasing up to threefold in the wet season. While the influent is mainly domestic, there are high trade waste loads from local restaurants and food-based industries, as well as irregular deliveries of septic waste.

Daily flows are currently 20–30% above the design specification and combined with septic shock events and high FOG (fat, oil and grease) loads, leads to ongoing problems with plant upsets, high oxygen demand, bacterial foaming, poor settling and high decant suspended solids.

The plant is a dual train Sequencing Batch Reactor (SBR), which runs on 4-hour cycles, consisting of a 2-hour fill period followed by 1-hour settle and 1-hour decant. At the end of the fill period, the inlet valve closes and the alternate basin inlet valve opens. The mixed liquor is aerated during the fill period and achieves an average DO of 2.5 mg/L.

WAS is thickened by a gravity drainage deck before entering an aerobic sludge digester. The digested sludge is fed to a belt filter press with the resulting dewatered biosolids transported offsite for reuse on farming land.

The most visible sign of issues with the plant came from the ongoing presence of bacterial foam in the SBR basins. While other plants in the area have seasonal occurrences of bacterial related foaming (dry season), the Atherton WWTP has an all year-round presence of the foam, which effects sludge settling and supernatant decanting.

There have also been ongoing problems with the aerobic digester and biosolids removal plant. The digester has not been operating efficiently, with independent reports indicating lower than optimal aeration, low nutrient uptake and high biosolid haulage costs.

A trial using the WTS 13-Biotifx Ultra treatment program was implemented to investigate whether the product could improve overall plant performance, decrease bacterial foaming and effluent suspended solids, improve aerobic digester performance and reduce biosolids transportation costs. The product had been used successfully in the USA for plants with similar problems.

WTS 13-Biotifx Ultra is a blend of 6 or 7 specially selected Bacillus strains in various ratios (depending on the application) combined with a proprietary blend of micronutrients that enhance the ability of natural bacteria to degrade organic pollutants. The highly efficient bacteria target FOGs and organic sludge as food sources and help to reduce the negative effects of the FOGs, septic waste streams and toxic events, and augment the native microbial populations.

In the first trial, the bioadditive product was slug dosed to the system at 5 mg/L (10 kg), with ongoing treatments of 1 mg/L (2 kg) dosed to the inlet structure of the plant on Monday to Friday. The dosing consisted of mixing 500 g dissolvable bags of powder into a 10 L bucket and pouring this suspension into the inlet structure of the plant. No special equipment was required.

In the second trial, the aerobic digester was directly treated by throwing a 500 g dissolvable bag of the bioadditive into the digester once per week.

Results

SBR Operation

The surface of one of the bioreactors before and after the start of the first trial is shown in Figure 1. Prior to dosing, there were several centimetres of thick foam covering the surface throughout the year. Once the dosing was started, the foam began to reduce and by the second week a very clear improvement was noted (Figure 1).

Figure 1. The surface of one of the reactors prior to the trial (left) and during the trial (right). The reduction in foaming is obvious.

Effluent suspended solids were often extremely high, with values above 100 mg/L seen six times in the two months prior to the trial (Figure 2). The average suspended solids in the effluent for the 30 days prior to the trail was 49 mg/L. Effluent suspended solids reduced rapidly once the trial started and by the second week, suspended solid levels remained below 10 mg/L.

Mixed liquor grab samples also showed improved settling. Figure 3 shows the SVI 60 values before and after commencement of the trial. The solids settled more quickly and produced a more compact sludge and clearer supernatant. This allowed an improved wasting cycle to the gravity drainage deck and aerobic digester, with a thicker sludge sent to the digester and better solids/liquid separation in the SBR (Figure 4). Wasting times were reduced from 80 minutes to 65 minutes due to the lower sludge levels in the SBR basins.

WAS volumes to the digester were also reduced significantly. Other possible improvements to the plant, such as reduced aeration cycles and energy costs, are still being investigated.

Due to the success of the trial in reducing foaming and improving the plant operational parameters, dosing has continued with ongoing good effect. Dosing has been reduced from the trial dose of 2 kg x 5 days per week (0.7 mg/L), to an ongoing treatment of 1 kg x 3 days per week (0.2 mg/L). The ongoing treatment cost has been reduced to $270 per week.

Aerobic Digester Operation

The most obvious benefit of the treatment of the aerobic digester was a reduction in sludge dewatering operation times 80–90 minutes per day to 45–55 minutes per day during the treatment period. Aerobic digester sludge volume was also reduced, thereby improving the wasting capacity of the plant and reducing the overall quantity of biosolids.

The reduction in the amount of biosolids can be seen in the average monthly haulage tonnes from 2018 (untreated) compared to the first three months of 2019 (treated). During 2018 an average of 99.7 tonnes per month was being hauled, which was reduced to an average of 86.0 tonnes per month during the trial (Figure 5). This equates to a haulage reduction of 13.8% and gives a cost saving of approximately $1,000 per month, a significant saving for the Atherton WWTP. This compares favourably with the treatment cost of $195 per month, to give an overall saving of approximately $800 per month.

Based on the success of the bioaugmentation treatment at the Atherton WWTP, its use has been extended to the other Tablelands Regional Council WWTPs of Tinaroo and Yungaburra where similar results have now been obtained.

The Authors

Anthony Ruge (anthonyr@trc.qld.gov.au) is a Water Treatment Operator with Tablelands Regional Council in Queensland and Scott Buckley (scottb@watertreat.com.au) is a Water Treatment Specialist with Water Treatment Services.

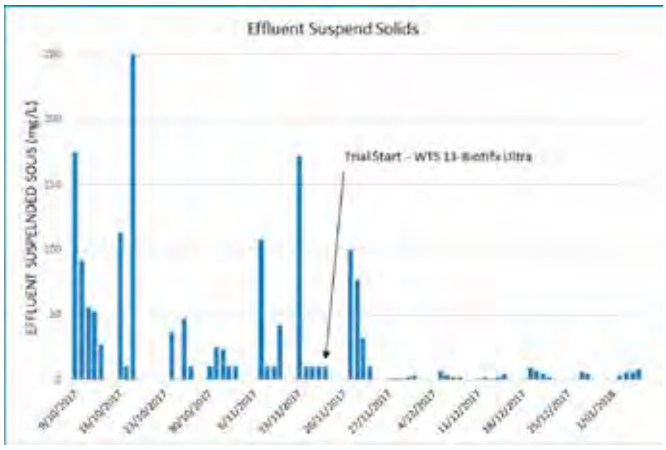


Figure 2. Effluent suspended solids before and after the start of the trial.

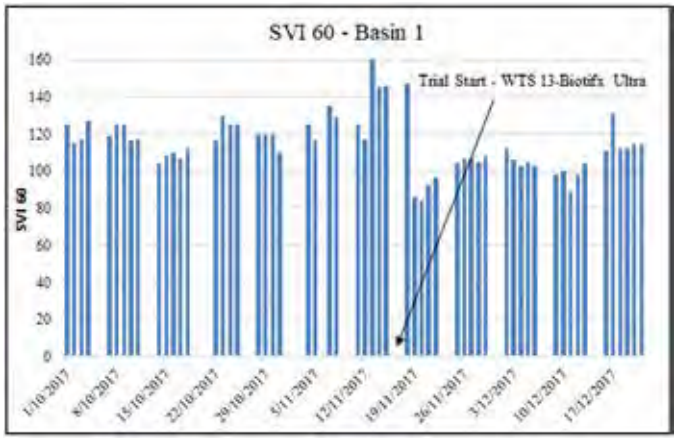
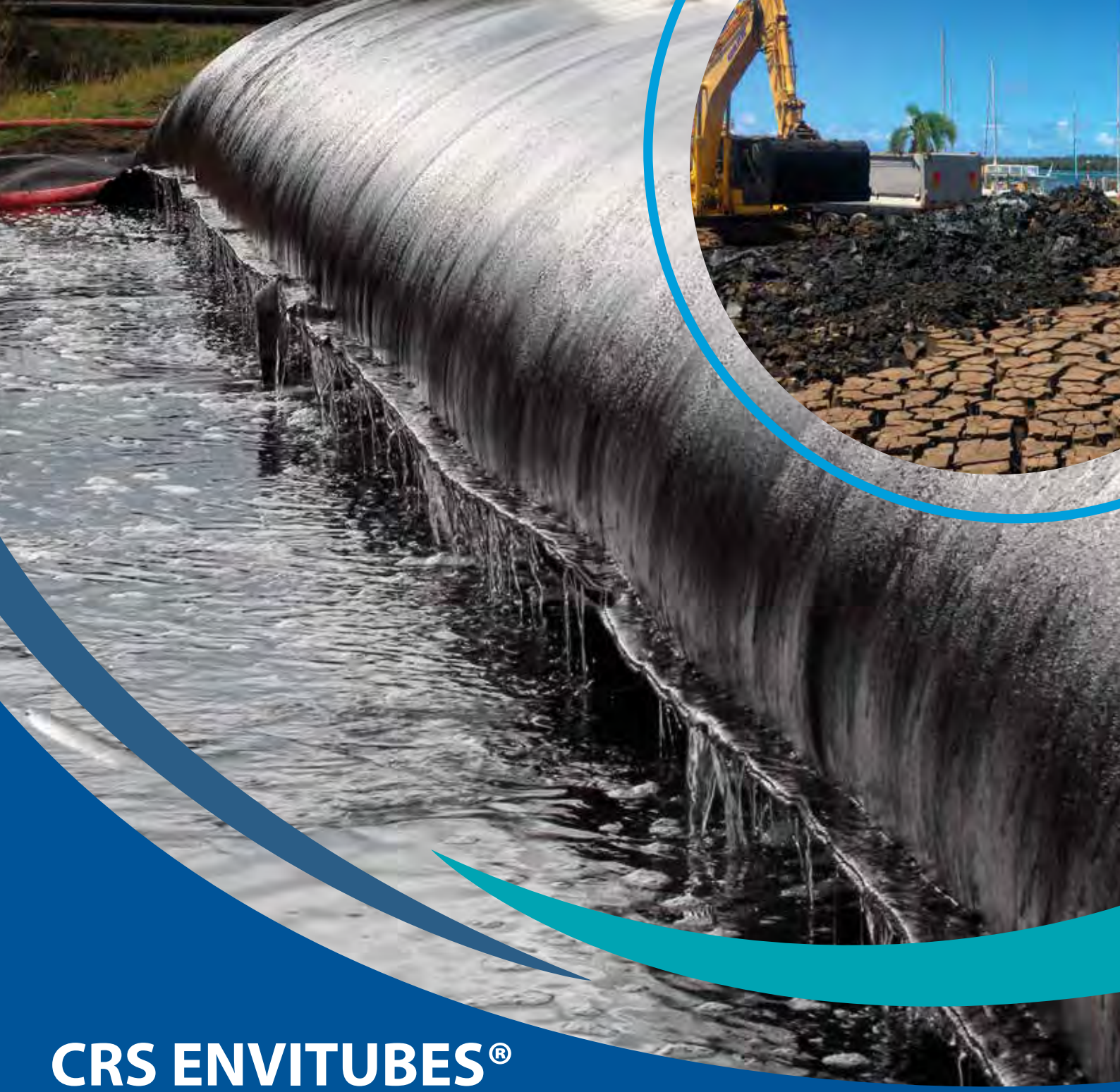


Figure 3. SVI 60 results before and after commencement of the trial.

Figure 4. The Atherton WWTP aerobic digester.

Figure 5. Average monthly haulage of bio-solids for 2018 (untreated) vs 2019 (treated).



CRS ENVITUBES®

HIGH STRENGTH WOVEN GEOTEXTILE BAGS PROVEN FOR:

- 24hr continuous unattended dewatering
- High feed flows
- Excellent filtrate quality and capture rate
- Low CAPEX and OPEX compared to centrifuge and presses

Contact

Ph: (02) 9899 7811
Email: crs@watertreatment.net.au
Web: www.watertreatment.net.au

Reach out for your free quote today!

CRS WATER
GRADIANT Company

ISA - UV/VIS SPECTROMETER SYSTEM

SIMULTANEOUS MEASUREMENT OF A WIDE RANGE OF PARAMETERS IN YOUR WATER OR WASTEWATER WITH ONLY ONE OPTICAL SENSOR

MEASURING

NH_4	BOD	COD	TOC	DOC
TSS	NO_3	NO_2	PO_4	UVT254

AND UP TO 200 FURTHER MEASUREMENTS

FUNCTIONS & FEATURES

- MONITORING FUNCTION
- INTELLIGENT EVENT HANDLING
- AUTOMATED CLEANING
- CALIBRATION MONITORING (SQI)
- ADJUSTABLE OPTICAL PATH LENGTH
- CLOUD DATA SERVICE
- DEPLOYABLE UP TO +110 °C
- REMOTE SUPPORT

NSW **0408 079 073**
VIC **0491 229 507**
WA **0437 742 859**
NZ **+64 (0)22 124 1100**
QLD **0437 742 859**
TAS **0407 342 113**
SA **0491 229 507**
HELP DESK **0407 468 568**

www.roycewater.com.au

Royce RWT Water Technologies