FRONT LINE WARRIORS

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ABSTRACT

An operator works on the "front line" of water and wastewater treatment, serving to protect environmental values and ensure quality drinking water and supply to the community. The emergence of rapidly evolving treatment technology requires operators to be multi-skilled and adaptable in a fasted paced industry. Operators often gain knowledge from the older generation of operators, managers and internal industry experts to become more well-rounded efficient operators for the 21st century. Based in the Pioneer Valley in Mackay Regional Council, the operations team oversees a variety of sites on the water and wastewater treatment side, from a recently commissioned 4 ML/day water treatment plant to groundwater bores with chlorination facilities to an overloaded but star performing water recycling facility. Given the regional nature of these sites, operators often travel over 1290 km per week and need to trouble-shoot electrical, mechanical and process control issues along with providing accurate descriptions of issues to maintenance, technical and management staff. In order to drive efficiencies and make these roles easier, operators have undertaken advanced training programs, implemented remote ClearSCADA control for process control and touchpads for data entry and remote SCADA.

1.0 INTRODUCTION

Hi all, my name is Dusty Brown and treatment operations is in my blood. My father was a treatment operator before me and I have been in the industry for 12 years and love every minute of it. I think I was born to be a treatment plant operator; the irony of me working on wastewater treatment plants with the last name Brown always gets a few laughs.

As an operator and front line warrior, my job is to protect environmental values and ensure quality drinking water and supply to the community. The industry's highs and lows, the characters and mentors I have encountered in my treatment pilgrimage have inspired me every day to go hard and learn more, to be more and to see the "clear supernatant side of life to every high load suspended solids (SS) test situation."

I have been with the Mackay Regional Council (MRC) for the past 3 years. It is made up of the former Mackay City, Sarina and Pioneer Councils. We oversee a variety of sites on the water and wastewater treatment side, from a recently commissioned 4 ML/day water treatment plant (WTP) to groundwater bores with chlorination facilities to an overloaded but star performing water recycling facility. We often travel over 1290 km per week and need to trouble-shoot electrical, mechanical and process control issues along with providing accurate descriptions of issues to maintenance, technical and management staff. No day is the same; there is a new challenge every day and nothing is ever cut and dry.

I am here today to give you a play by play of the battles we encounter as front line warrior treatment plant operators in our day to day lives.

2.0 BATTLE ONE – THE WATER RUN – FIRST TEST

When I first arrived to MRC, my first operations battle field was what they call the "water run." We march up the valley checking 6 minor water treatment installations.

They are low sunk bores where the groundwater is disinfected with liquid sodium hypochlorite, stored in various sized reservoirs on hills and gravity feed via mains to regional towns. You can see the distance between sites in Figure 1.

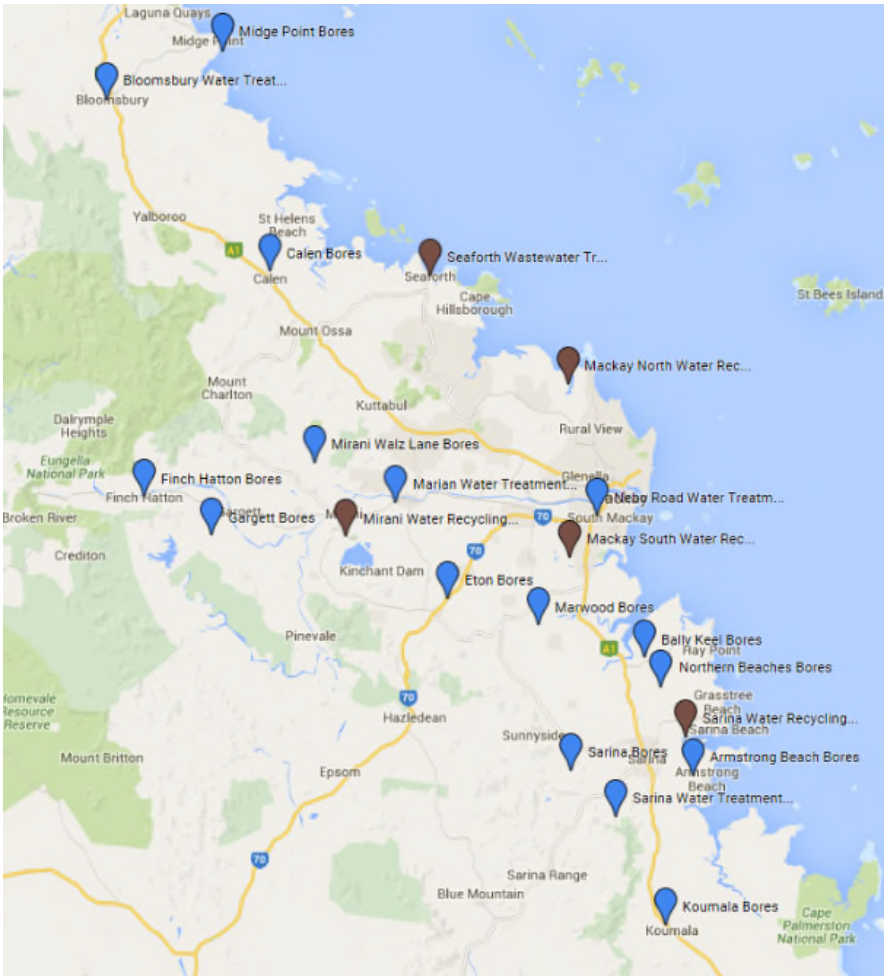

Figure 1: ***Mackay Regional Council Treatment Assets.***

These systems are simple to run and require basic treatment know how, which made the front line warrior side of me go into an idle sleep mode. I was looking for a challenge, for my next battle.

2.1 Bloomsbury Water Treatment Plant

The Bloomsbury WTP supplies the community of Bloomsbury of around 350 people located 86 km north of Mackay. The annual water demand is about 22 ML. Bloomsbury sources its raw water from a bore associated with the O'Connell River. When I first arrived to site on the water run, I didn't even think this was a treatment plant because it was just a few tanks and a container. My teammate showing me around said this was where the magic happened but I was really sceptical.

The existing bore pump has a capacity of 3.1 L/s supplying water to a 27 kL raw water tank. The raw water is dosed with sodium hypochlorite and filtered through two upright DMI-65 catalytic water filtration media sand filters. The raw water quality characteristics are provided in Table 1 where we see high levels of iron and manganese. These filters were chosen specifically to remove these elements.

The disinfected water is recirculated through the WTP and raw water tank maintaining a residual free chlorine level until the level of treated water drops to a fill level in the two storage tanks (Filtered and Clear Water Tank). Treated water is pumped into the network at a set pressure.

Table 1: ***Bloomsbury Raw Water Quality Compared to Australian Drinking Water Guidelines (2011).***

	Manganese (mg/L)	Iron (mg/L)	Hardness (as calcium carbonate (mg/L)
Bloomsbury			
Maximum	1.88	2.04	177
Minimum	0.065	0.026	109
ADWG 2011			
Health	0.5	-	-
Aesthetic	0.1	0.3	200

The system uses sodium hypochlorite as a critical catalyst. When passing through the filters it converts the soluble manganese and iron to insoluble particulate manganese and iron through precipitation. The filters take up the particulate ions until a filter meets its flow time of head pressure and then backwashes.

Like I said: Voodoo MAGIC.

2.1 Issues & Solutions

This plant was continuously polishing water which created issues with wear on the pneumatic valve diaphragms. The backwashed water pumped back into the system had high manganese and iron content which created issues with filter performance and wear on the valves along with increased power consumption.

To fix these issues, our team came up with a new SCADA program to reduce polishing times and implemented a regular pump out regime to remove particulate manganese and iron at the bottom of the backwash tank. We all worked together as a team, bringing in internal gurus on electrical programming, one of whom has been with MRC for a very long time and has a lot of knowledge, working to troubleshoot chemistry issues to put together a workable plan. We now monitor that site remotely with the changes we have put into place and have reduced the number of callouts which means less time on the road and more time to focus on other scuffles and skirmishes.

2.0 BATTLE TWO – THE SEAFORTH WASTEWATER TREATMENT PLANT – THE OCCASIONAL BATTLEGROUND

The Seaforth Wastewater Treatment Plant (WWTP) is an intermittent decant extended aeration system (IDEAS) where influent flows into the reactor on a constant basis with the exception of the settling cycle. Raw sewage is collected by three pump stations to the pre-treatment area which has two 10 mm manual bar screens. The inflow is directed to a 43 kL flow balance tank with a mechanical mixer so flow and organic load is balanced heading to the bioreactor. The bioreactor is designed to operate on a fill and aerate, settle and decant cycle. Diffused air is supplied by a blower operating on high and low dissolved oxygen (DO) set points or a timed cycle.

A floating decanter draws off supernatant from the surface of the bioreactor.

Disinfection happens with chlorine tablets and the flow of water through the decanter is controlled to get effective contact time. The effluent is filtered through a cartridge type rapid sand filter prior to storage in the two 43 kL wet weather storage tanks and then to the irrigation system on dry days. The effluent soakage trench (total area 340 m^2) is made of gravel and topsoil layers with subsurface irrigation.

2.2 Issues & Solutions

The WWTP services a caravan park which sees a lot of variable flows. These are an issue that impacts how the plant performs. We managed this by replacing the alum dosing system with a D-nitro sugar dosing system to create a synthetic carbon source during low flow periods. The alum dosing system was not required due to the environmental license conditions so this was a practical, cost effective solution.

We worked with our internal SCADA team to make modifications to the control system and SCADA programming and added a new programmable logic controller (PLC). Through some challenging field testing, we ironed out the kinks and went live to SCADA. Our operations team needs to be on its toes monitoring this plant, adjusting the aeration, settling and decant times so we have made an extra effort to make sure we are skilled up on this aspect by learning as much as we can about how these systems operate.

3.0 BATTLE THREE – MIRANI WATER RECYCLING FACILITY – THE SEASONED VETERAN

The Mirani Water Recycling Facility (MWRF) is a sequence batch reactor (SBR) which was upgraded in 2010 from a conventional aeration sequence batch reactor and UV disinfection system with the addition of flow balance tank, clarifier and return pump system. The mining boom brought up the numbers feeding into the plant and soon it was overloaded.

3.1 Issues & Solutions

The plant is overloaded (inflow was as low as it could be set), retention time in the bioreactor was at a critical point and we were trending high on ammonia in the effluent. Our chief ground commander (our Treatment Coordinator) rallied his troops and asked us all to put our heads together to solve these problems.

Using the skills gained from our well-seasoned senior operator, the plant went from a sequence batch reactor to a continuous flow process. One of the old mixed liquor suspended solids (MLSS) waste activated sludge (WAS) pumps was converted to an A-recycle pump that feds from the back section of the bioreactor to the front section in-between the raw and return activated sludge (RAS) feeds. This helped with getting the active bugs back to the fresh carbon sources plus the saturated air content of the A-recycle liquor helped prop up the DO in the front section of the bioreactor.

With this solution, we found that the process was now predominantly denitrifying in our clarifier. This made it possible to lift the sludge blanket in the clarifier as the nitrogen gas is converted from nitrate and nitrite, with at least extreme pin floc carry over.

The front line team sat down and devised a plan of attack: we needed to keep lower non-filterable residues (NFR) in the RAS and MLSS and balance the return so it would not affect either the bioreactor or the clarifier. It gets tricky sometimes but that is why we are front line warriors. We have kept a close eye on this process at the same time implementing a new data management system with Monitor Pro called MPField. We have touchpads with remote site control from anywhere on the battle field which gives us immediate feedback on plant performance and data trending. We also have access to SCADA while we are out in the trenches.

As operators, we have had to step up to meet the challenges of catching on to evolving treatment technology which is a fast paced and doesn't show signs of slowing down. On our team, we have also done a lot of training programs including the Certificate 4 in Treatment Operations, internal led SCADA control and process principles.

4.0 BATTLE FOUR – THE MARIAN WATER TREATMENT PLANT - THE FINAL FRONTIER

In 2015 we commissioned the new Marian WTP shown in Figure 2. It is a conventional package WTP with the integration of lamellar plates in the clarifiers. The maximum flow rate of this plant is 55 L/s which is pumped from the Pioneer River. This plant is designed to treat up to 500 NTU but as we are front line warrior operators we believe we can push it far past that.

Figure 2: ***Marian Water Treatment Plant.***

4.1 Issues & Solutions

With a new WTP there was a lot of new treatment technology, unfamiliar lab equipment and a new online analyser to track organics which was a bit daunting for our team. Gaining an understand of the process, how the lamellar plates impact treatment and not having to keep a floc cloud in our clarifiers was a new idea none of us had worked with before. Getting to know how the vast number of interlocks worked and how they governed the plant operates was not easy.

A big part of this was getting our team comfortable and familiar with the new technology, and to believe in their skills to run the new plant.

Our team had never been involved in the design, construction and commissioning of a new plant before so this was a challenging but rewarding experience. The lessons we learned and the advancement of my water treatment process principles and lab testing skill, help me to become a well-rounded operator for the 21st century. I learned that you always need to stay current with your knowledge, you need to adapt to changes and you need to challenge the process.

5.0 CONCLUSION

You've stepped through the battles we as operators at MRC face but what I believe we represent are the operators across the state and country who are periodically working outside their comfort zone, having to become more accepting and more comfortable with the new technologies that are being implemented in treatment operations. It seems sometimes the job we do is a thankless one, so I'd like to take a moment to say thanks for protecting the environment from wastewater issues so there is an environment there for when our kids get older. Thanks for providing clean potable drinking water for our communities, free of impurities and harmful pathogens. We truly are the first and sometimes last line of defence as front line warriors.

6.0 ACKNOWLEDGEMENTS

I would like to thank MRC for providing me the platform to advance my skills in my chosen discipline and for allowing me the opportunity to represent the organisation at the Water Industry Operators Association conference. I would like to thank my operations teammates for the support: Brendan Rolfe, Mark Vairy, Ashley Reidy and Daniel Blyton. Our always helpful and knowledgeable internal telemetry, electrical and mechanical teams need special recognition as we would have a hard time on the front line without them. Many thanks go to my mentors, Michael McAuley, Stuart Boyd, Janice Wilson and Gary Frazer. Special thanks to my co-author, Treatment Engineer, Janice Wilson for convincing me that I had something worth saying.

7.0 REFERENCES

DMI-65 "DMI-65 Catalytic Filtration Media: How it Works". Quantum Media Filtration. Accessed Monday 11 April 2016 http://www.dmi65.com/dmi-65/how-it-works/.

Mackay Regional Council Bloomsbury Treatment Facility 2014-011 Functional Description Revision 0, n.d.

Mackay Regional Council Marian Water Treatment Plant 2013-088 Operation and Maintenance Manual, 23/01/2015.

Mackay Regional Council Mirani Wastewater Treatment Plant Unit Process Guideline, Intermittent Aeration & Continuous Flow Unit Process, MRC:WLS:MIRANI:UPG-01, 26/05/2014.

Mackay Regional Council Seaforth Sewerage Treatment Plant Functional Specification, Revision 2, 28/01/2014.