FROM PREHISTORIC TO ARTESIAN GOLD - A JOURNEY IN WATER QUALITY IMPROVEMENT

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ABSTRACT

Richmond is a small outback community approximately half way between Townsville and Mt Isa and has since the dawn of time been supplied with water from the great artesian basin via two bores with differing water qualities. The presence of iron and Manganese and the aroma of sulphide were the key issues requiring rectification. It was a long road from conception to implementation of the new water treatment plant which involved some challenging aspects both for council and those who ultimately won the job of developing the process and implementing the system. Beginning with laboratory assessments of process options then upscaling to pilot scale trial to verify the process performance, a simple yet effective combination of treatment options was developed around existing infrastructure the Council had purchased.

1.0 INTRODUCTION

Richmond, like many towns in western Queensland draws its water from the Great Artesian Basin. Although not as highly contaminated with the metals Iron and Managanese as some Queensland water supplies, evidence of their presence is readily observed throughout town by the orange and brown staining on most buildings as one drives into town. The other key issue which was more prevalent in one bore than the other was the presence of sulphides, which for those new to town came as somewhat of a shock when they turned on a tap or had a shower. The poor quality of water was made more apparent to council following the construction of the Ammonite Inn which provided increased capacity for tourists who gave unpleasent feedback regarding the water quality.

Richmond lies in the outback Queensland dinosaur triangle, being home to Australias most complete dinosaur skeleton and a noteworthy museum containing many dinosaur skeletons and fossils. A key attraction for tourists and paleontologists is the opportunity to go fossiking for fossils and dinosaur bones with the resident museum curator and visiting peleontologists from all over the world. In order to promote their town and increase the tourism generated by the ancient history found beneath the red dirt, Council then made the decision that something had to be done to improve the water quality. Not only to provide a reason for tourists to visit and stay in Richmond, but possibly more importantly not give them a reason to leave prematurely.

Council was awarded a state government grant to improve their water supply and embarked on a journey of development and improvement that took several years to complete. After being awarded the funds, Richmond Shire Council (RSC) purchased several skid mounted pressure filtration plants from Melbourne Water which were largely unused and had become redundant on commissioning of the Wonthaggi De-salination plant.

The next challenge was to find a company that could design a process around this infrastructure and deliver it in a cost effective and timely manner. As quotes came in the budget wasn't sufficient, and council couldn't make up the shortfall in funding when we happened on an emerging water treatment company from south of the border called Aeramix.

Aeramix offered a novel approach to development of the process utilising extensive on-site assessment of the process options and subsequent pilot scale testing to ensure a process that made maximum utilisation of the assets council had already purchased. They were also willing to utilise and engage council staff in their investigations into process options and then continue to utilise council staff and local contractors in the construction and commissioining of the plant supporting the local community. This gave us as RSC plumbers, soon to be WTP operators a much improved understanding of the plant and how it was to operate once completed.

Results were promising after pilot scale testing and assessment of different filter media configurations, where samples entered into the QLD Water Directorate – Orica water taste test, not only won the best water in the north west, but also won the best tasting water in all of Queensland. An achievement that set the bar high for expectations when the full scale plant was delivered.

Figure 1: ***A Temporary Laboratory Established Under a House.***

A process utilising mechanical and chemical oxidation followed by coagulation and direct filtration via a dual media filter ararngement and sodium hypochlorite disinfection was selected. Detailed design started in July 2014 and construction commenced in September. The skids were de-mounted and all mechanical equipment assessed and tested to ensure the now 5 year old equipment was in working order and would be fit for use. Commissioning began in Mid February 2015 and the plant has now been operating and delivering compliant water to town since the 10th March 2015.

2.0 DISCUSSION

2.1 Design and Construction

There was a lot to do and resources were limited, but we forged ahead under the guidance of Aeramix as we moved from concept to construction. Having the opportunity to assist with the testing of equipment de-mounting of skids and development of the process was an eye opener. For an outback plumber, this was highly advantageous when it came time to learn the operation of the plant. It was also a great learning experience understanding the challenges faced when coordinating such a project which comprised political, community, logistic and contractor management issues.

The project team consisted of Richmond Shire Council as Superintendant, Aeramix (Civil, Process, Mechanical and Hydraulic design construction and integration), Queensland Engineering and Electrical (Electrical design and PLC Programming), Golden Run Contracting (anything and everything!), EA Martin and Sons (Electrical installation), Tank Industries and Richmond Shire plumbing staff and roads crew.

Key activities that our council team were involved in were as follows:

- Assistance with set up and running of pilot tests assessing aeration nozzles and critical process components.
- Dismantling of skids
- Review of process layout and selection of preferred options
- Design review and participation in Risk review workshops and identification of failure contingencies such as bypasses of various process
- Pressure testing filter vessels (three failed!!)
- Construction of a 2km pipeline from Bore 6 to Bore 5 where the WTP would be situated
- Site preparation and earthworks for the construction of a 1.5ML clear water tank
- Installation of pipework and valves
- Review of PLC/Citect interfaces (which I didn't really understand but am now quite confident in)
- Community liaison – public meetings and general promotion and awareness tasks
- Commissioining and;
- Operation.

We developed procedures and processes for testing of equipment and worked closely with the team to assess and quality test key pieces of equipment. This was a time consuming but in the end very worthwhile activity as multiple failures of equipment were identified along the way which would have caused havoc in commissioning had they not been identified prior to installation.

Although 95% of the pressure vessels passed the pressure testing, the pneumatic actuators were a different story. Of approximately 140 actuators that came with the skid mounted systems, something like 25% failed due to a variatey of malfunctions. Fortunately we identified enough actuators in working order to satisfy the design requirements of the plant and so far there have been no failures. The team certainly did their best to minimise cost and utilise this equipment, however we were aware of the inherent risks using the second hand components would place on the ongoing operation and performance of the plant.

Figure 2: ***Actuator Test Bench and a Failed Actuator Damaged by Water***

The detailed design and 3D drawings looked promising and the reconfigured components were arranged to fit an existing slab. Although the initial design only had two trains of 6 filters, council had additional vessels they were keen to utilise, so a revision produced a design with three trains of five filters with three flocculation tanks each. This also provided redundancy and capacity to maintain supply during planned or corrective maintenance.

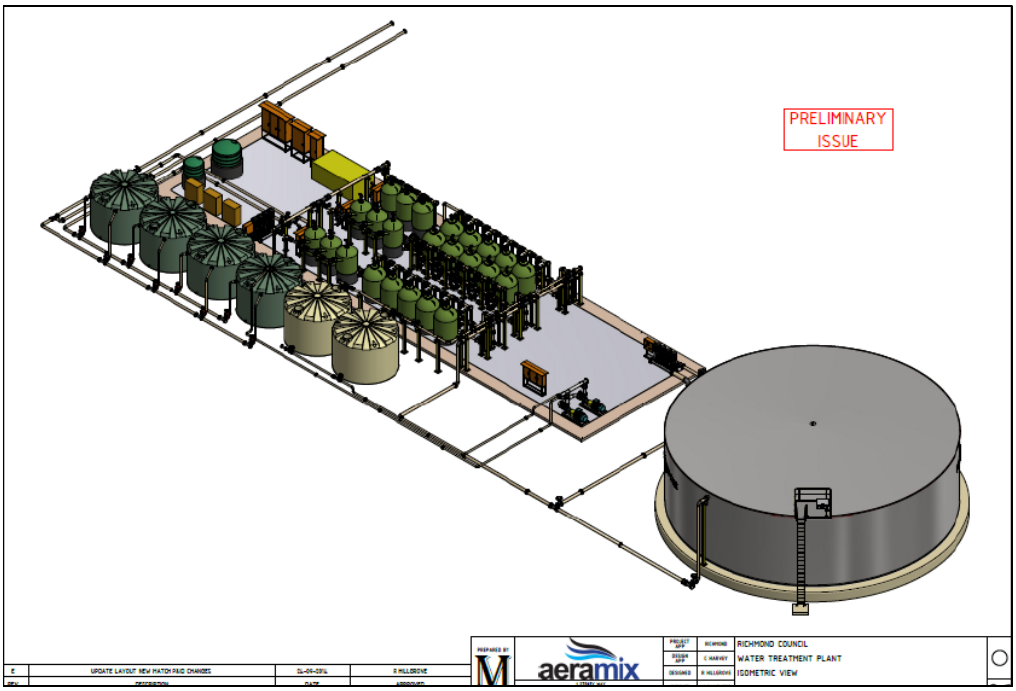

Figure 3: ***3D Image of Proposed WTP Layout***

Construction proceeded well, with some short dealys experienced for the normal range of reasons. Equipment was delivered to the wrong Richmond on a couple of occasions and any oversights in requirements were compounded by our remote location and some inconsistencies in transport company routine runs to Richmond. Sometimes items would arrive in Townsville then sit there for a week or more awaiting the next run to Richmond. There were also delays with the upgrade to the power supply required to run the plant. With the initial aim to deliver the plant before Christmas, the new power supply was not installed until mid December postponing any early commissioning.

2.2 Commissioning and Operation

As with all new designs and installations we had some teething problems after initial electrical and hardware commissioning as we moved into process commissioning. Also our time on site was sometimes limited because we all had our 'normal' jobs to do such as repairing broken water mains and attending to other routine tasks. This limited our ability to get too involved in the early phases of plant operation and training was somewhat segmented, but we got there in the end.

The plant has been producing a high quality water, and the resturaunts in town are now serving tap water at the table rather than bottled water which was used previously. Early data from the plant is shown below.

Table 1: ***Early Water Quality Data from the Richmond WTP***

Parameter	Treated Water
pH	7.5
Conductivity	525 us.cm
Iron	<0.005
Manganese	0.02
Turbidity	0.2
Colour	<1
Aluminium	0.059

Data obtained from independent sample collected by QLD Health at the home of a local dialysis patient.

Unfortunately things haven't always gone to plan. The curse of second hand componentry has led to some minor equipment failures, but although they are only minor components they had some significant impacts on process performance. Despite the plant running well and producing great water, the backwash system which utilises a large backwash water holding tank followed by a lamella plate separator to facilitate sludge removal and supernatant return was assembled using the original pumps that came with the skids.

The separator feed pump has failed a number of times, ultimately requiring replacement. This led to filters backing up for backwash, but with capacity only available to backwash one filter train every 12 hours or so, we have had occasion where filters have been locked out of backwash and operation due to high level alarms in the backwash holding tank. These physical failures also highlighted some need for change in the process control logic.

While we managed to maintain supply, we have had one incident where iron and manganese breakthrough was observed and subsequent turbidity to town reached as high as 0.6 ntu. Although still compliant with the guidelines, it was easily noticable now that we had become accustomed to the pure clean water that the plant had been producing and the metallic taste historically present in the water returned. It's amazing how quickly we adapt to improved quality, and once we had it how noticable it became when it returned to similar quality to before.

Another issue which has caused issues in the plant is an irregular power supply. Although the plant has a generator which starts within 30 seconds of a power failure and maintains operation of the plant, we have experienced regular alarms and on a couple of occasions failure of the town pressure pumps due to over voltage, undervoltage power issues.
Fortunately for me we have had continued support from Aeramix in analysing the process

and addressing the issues both remotely and on site via the capacity for their team to log into the plant from afar. We talk daily and trouble shoot issues which has been another great learning experience for me as a newly crowned WTP operator.

2.3 The Towns Response

When the plant was connected to the town supply it was amazing. Within three days we were near crisis with town consumption going through the roof, although the plant has capacity to produce an additional 50% supply to historic demand, this historic demand was somewhat dictated by the way the previous system operated. When demand went up, pressure generally went down as the bores had a limited supply capacity. However, once the town was being fed off a constant pressure pump set which was not limited in volume of supply due to the integration of the clear water storage tank, town flows exceeded all historic records peaking at around 63 L/sec. Historically this flow rate could never be achieved because the bores supply systems max out at 39 L/sec.

Day after day the clear water storage dropped another 15% taking 1 step forwards and two steps back. A community meeting was arranged and Mark Samblebe from Aeramix was at a point where he had little option but to inform the town that if they continued to consume water in such a fashion (approximately 10,000L per person per day) then they would ultimately run out and he would have to take steps to control flow from the plant. With the improved pressure, sprinklers that used to trickle a steady flow to water a lawn were now spraying twice as high and wide, so watering time either needed to be slashed or the taps throttled back to reduce flow.

Council also took the initiative to implement water restrictions, which once formalised had an immediate impact with average day time flow rates of 20-30 L/sec suddenly dropping to 8-12 L/sec. A commendable response from the community which avoided alternative controls being needed.

3.0 CONCLUSION

In conclusion, it has been a rewarding project for all involved and for the township of Richmond. The local community and travelling tourist population now has a great tasting supply with no odour and the iron and manganese levels reduced preventing staining.

4.0 ACKNOWLEDGEMENTS

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