

CENTRAL HIGHLANDS MAINS CLEANING



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ABSTRACT

Maintaining water quality in water distribution systems is of paramount importance to reduce the risk of waterborne contamination affecting customers. Programmed mains cleaning, in conjunction with suitable disinfection systems, is one tool a system operator can use to minimise the risk of contamination. There are a number of methods available to clean water mains including flushing, air scouring, swabbing (pigging), disinfection and jet rodding. The latter method is a tool of last resort and can have significant detrimental affects on the main if not undertaken correctly and in conjunction with mains lining. The townships of Beaufort and Blackwood in the Central Highlands region of Victoria have UV disinfection and have undergone mains cleaning and disinfection trials over the last 2 years.

1.0 INTRODUCTION

United Water International operates the water treatment facilities for 5 water supply systems for the Central Highlands Water Authority in central Victoria. As part of the contract the water supply to two towns, namely Beaufort (population 1200) and Blackwood (population 700), are provided with continual UV disinfection along with supplementary mains cleaning and disinfection to ensure the microbiological quality of the supplies.

This paper discusses the background to the project together with a description of the process used and the difficulties encountered. The success of UV disinfection combined with mains air scouring and chlorination at both towns is also discussed.

2.0 BACKGROUND

Prior to May 2005 the townships of Beaufort and Blackwood were supplied with water that was UV disinfected but had no further treatment. The water quality in these networks did not meet potable standards as shown in Figures 1 & 2. Central Highlands Water's commitment to improve water quality resulted in treatment plants being commissioned in May 2005 and United Water has been operating the facilities since that time. The final stage in each treatment system is UV disinfection prior to distribution to customers, there is no chlorination in either system. Whilst UV disinfection provides adequate kill rates for water supply it does not provide any residual disinfection to avoid regrowth of contaminants in the water supply network.

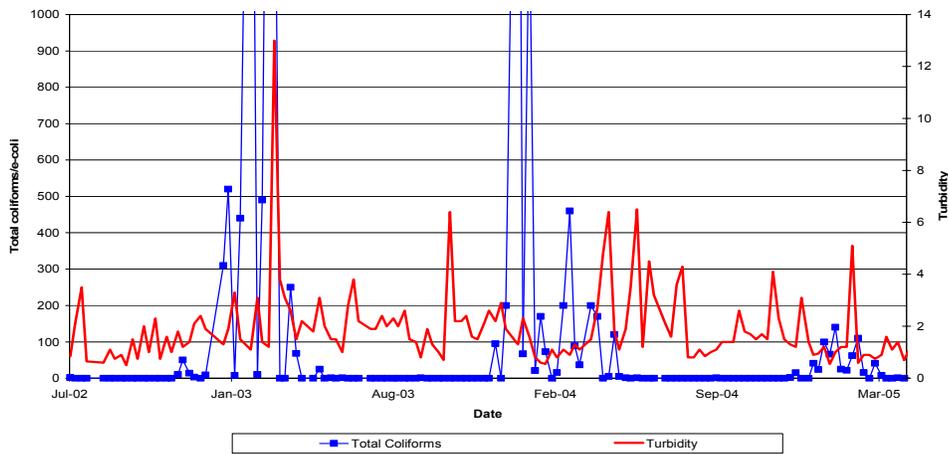


Figure 1: *Blackwood Network Coliforms and Turbidity*

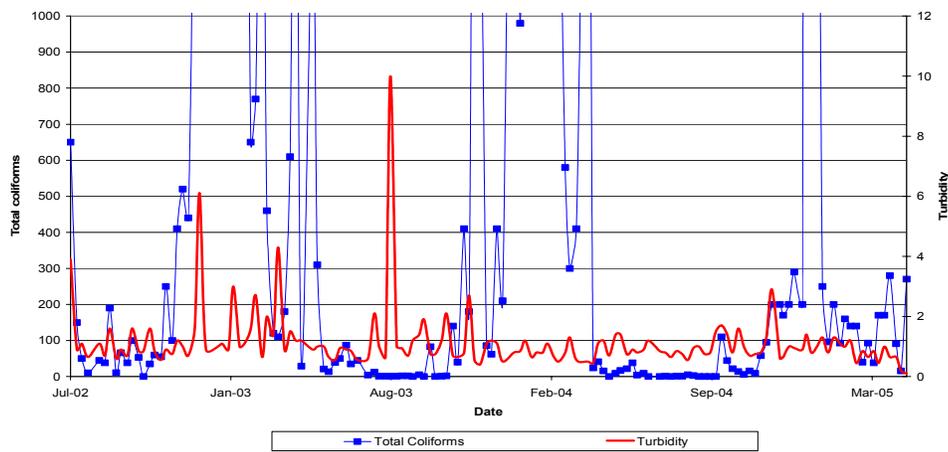


Figure 2: *Beaufort network Coliforms & Turbidity*

A key component of the contract for operating the treatment facilities is mains cleaning of the networks. Table 1 shows the initial type and frequency of cleaning for each town.

Table 1: *Initial Mains Cleaning Schedule*

Cleaning Technique	Extent	Main sizes (mm)	Frequency
Beaufort			
Flushing	20 dead ends	75 – 100	Every 2 months
Air Scouring	25 km	75 – 300	Yearly
Swabbing	5 km	300	Yearly
Disinfection	30 km	75 – 300	Every 6 months
Blackwood			
Flushing	25 Dead Ends	100	Every 2 Months
Air Scouring	16 km	100 – 150	Yearly
Disinfection	16 km	100 - 150	Every 6 Months

The Beaufort water network is an old network with the oldest main dating back to the early 1900's with the majority of pipe being asbestos cement. The Blackwood system is newer, circa 1983, with the mains all PVC.

United Water's Adelaide operations utilised flushing, swabbing and mains disinfection, with gaseous chlorine, as the primary methods for mains cleaning and had not utilised air scouring since the early 1990's. The Central Highland's contract specified air scouring and mains disinfection with liquid chlorine therefore the purchase of air scouring equipment and the use of the back up liquid chlorinator was required. A 268 CFM air scouring unit was purchased for this work.

3.0 MAINS CLEANING IN BEAUFORT & BLACKWOOD

As with any planned maintenance planning is the key to a successful outcome. The planning phase of the Beaufort and Blackwood exercise commences a few months before hand. The schedule is now well documented and plans of each cleaning block are kept. However, these plans need to be updated prior to each exercise to take account of any network changes. The critical customers in each town need to be contacted at least one month prior to ensure that they will not be unduly affected. All customers are contacted via mail by Central Highlands before any work commences and each customer is notified 2 days prior to their individual supply being cleaned by United Water. Difficulties have been experienced, particularly in Blackwood, with quite a few customers not having letter boxes or access to lodge the final notification.

The primary trunk main feeding each town is the first to be cleaned during each exercise and needs to be done at night as the entire township will be without water during cleaning. When key customers, such as hospitals restaurants and hairdressers, are affected by any cleaning activity, and they do not have dual services, United Water provides temporary pressurised supplies. The service to each customer affected by a cleaning run requires isolation prior to commencing that run to avoid dirty water getting to the customer during air scouring and highly chlorinated water during disinfection. The customer is required to isolate their boundary cocks themselves, however each service needs checking as approximately 30% of customers do not isolate their service.

The major equipment used for air scouring is a compressor unit and air filters, filter bags, lay flat hose and standpipes. Figure 3 shows the trailer mounted air scouring unit Figure 4 shows the filter bag in use.



Figure 3: Trailer Mounted Air Scouring Unit



Figure 4: Filter Bag

Following each air scouring run, the main requires disinfection. This is achieved using a 12.5% sodium hypochlorite solution injected into the main and left for 3 hours. A minimum of 10 mg/L free chlorine is to be measured at the end of 3 hours. Once the required dose is achieved the highly chlorinated water needs to be removed from the main. This water needs to be dechlorinated prior to discharge to the environment which is achieved using a sodium thiosulfate solution injected into the discharge stream. An alternative method of dechlorination is to pass the discharge water through a diffuser containing ascorbic acid tablets, however, care must be taken with this method as it is not as affective at reducing chlorine at very high concentrations and the level of chlorine in the discharge must be checked. Figure 5 shows the mains dosing trailer, Figure 6 the temporary supply trailer and Figures 7 and 8 the two dechlorinating methods.



Figure 5: *Disinfection Trailer*



Figure 6: *Temporary Service Trailer*



Figure 7: *Dechlorination Diffuser*



Figure 8: *High Concⁿ Dechlorinator*

The mains cleaning exercise in Blackwood takes 10 days to complete. In Beaufort approximately 5 km of the 300 mm diameter main feed to the town requires swabbing once a year and disinfecting twice a year in addition to the air scouring and disinfection. This is undertaken at night and is done before the rest of the town is air scoured. The mains cleaning exercise in Beaufort takes 15 days to complete.

4.0 RESULTS AND DISCUSSION

4.1 General

UV disinfection of untreated water did not provide potable drinking water and boil water notices were in place for both Blackwood and Beaufort. Treatment plants for both towns were commissioned in May 2005 and a 12 month trial mains cleaning program was instigated upon commissioning. The results of the trial were evaluated in June 2006.

4.2 Blackwood

Figure 9 shows the network turbidity and total coliforms before and after the treatment plant commissioning and mains cleaning program. It can be seen that the network turbidity has decreased since the introduction of the treatment plant and the mains cleaning program.

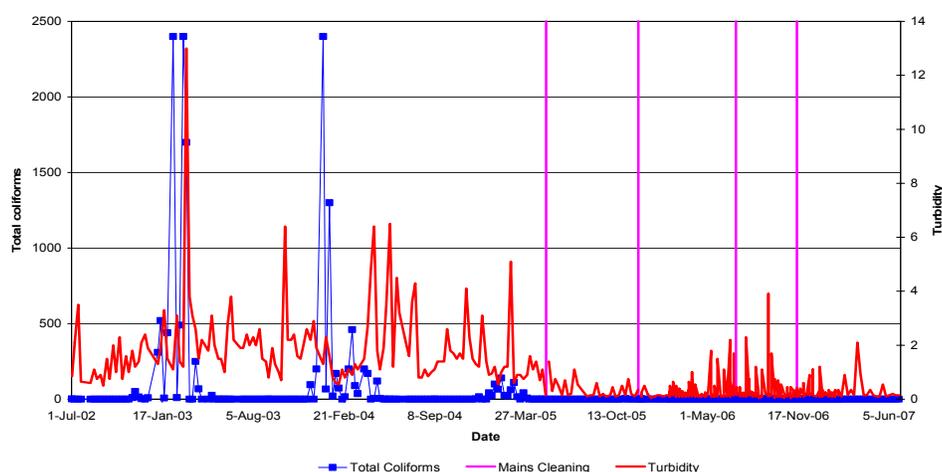


Figure 9: *Blackwood Network Total Coliforms and Turbidity*

Water treatment together with mains cleaning and UV disinfection has been successful in maintaining adequate bacteriological water quality and the boil water notice was lifted in June 2006. Customers are inconvenienced by water outages for 2 nights and 2 days per year whilst mains cleaning is undertaken. Treated water is discharged to stormwater during mains cleaning and disinfection processes. It is important to remember that good maintenance practices, ie burst main repairs, are important to maintain a supply free from bacteriological contamination in a water network that has no disinfectant residual.

4.3 Beaufort

Figure 10 shows the network turbidity and total coliforms detected from July 2002 to June 2007. It can be seen that the turbidity has improved since the treatment plant came on line in 2005. However total coliforms have been detected in the network between May 2005 and June 2006 which indicates that the mains disinfection trial had not been successful in maintaining adequate bacteriological water quality in the network.

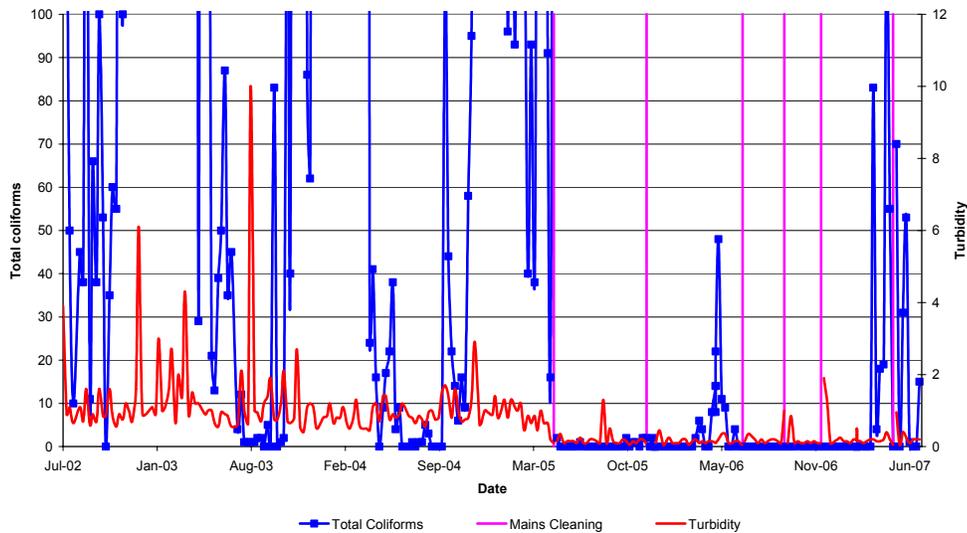


Figure 10: *Beaufort Network Coliforms & Turbidity*

The trial was extended for a further 12 months at an increased frequency twice that of the original program. It can be seen that total coliforms still persist in the Beaufort network and the results of this trial are currently being evaluated by Central Highlands Water. The boil water notice remains in place and customers are inconvenienced by water outages for 2 nights and 4 days per year with the upgraded mains cleaning program. Treated water is discharged to stormwater during mains cleaning and disinfection processes however it can be recycled back to the reservoir at significant cost/kL by utilising tankers. It must be stated that this is very impractical if it is expected to capture all of the discharged water as tankers can not keep up with the cleaning process. Beaufort has an old water supply network, with a high failure rate, compared to Blackwood, it consists of various pipe types which have, for the majority of their life, transported untreated water, it is not unexpected to see the results obtained.

5.0 CONCLUSIONS

UV disinfection, in conjunction with treatment and appropriate maintenance practices, can be successful in maintaining adequate bacteriological water quality in water supply networks. The success rate will depend on the age and type of water network and the maintenance practices. Trials on a case by case basis are required to establish cleaning frequencies, costs and labour requirements. Public consultation is extremely important for a mains cleaning exercise and when considering options for water supply, particularly if passing on costs to customers.

6.0 ACKNOWLEDGEMENTS

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