CHALLENGING OPERATIONAL PROBLEMS AT THE BACCHUS MARSH WATER TREATMENT PLANT

Paper Presented by :

Wes Wittick

Author:

Wes Wittick,
Operator – Bacchus Marsh & Merrimu WTP's

Western Water

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Wes Wittick, *Plant Operator*, Western Region Water Authority

ABSTRACT

The water treatment plant at Bacchus Marsh, operated by Western Water, supplies drinking water to the township at demands of up to 15 ML per day. The plant has recently encountered a number of operational problems, due to deteriorated raw water quality.

The plant is of pressure filter design and was formatted to treat reasonably good quality raw water. When the Turbidity and colour increased dramatically, the filter run times were reduced from 24 hrs to 2hrs maximum. At this point we looked at dosing Alum into a 40 Ml raw water storage basin sited at the plant, from which the filters draw. After some trials and tribulations it clarified the water beyond expectations and the pressure filters were pushing out .05 NTU water. As we expected the fairytale did not last. Taste and Odour problems were upon us. This paper works through initial control measures, the addition of Granular activated carbon to filters and raw water basin cleaning.

KEY WORDS

G.A.C., Geosmin. M.I.B., T.C.A.

HISTORY

The Bacchus Marsh Water Treatment Plant (WTP) was opened in 1958. Its original configuration was a conventional type plant, consisting of clarifiers and rapid gravity sand filters; it also employed the lime/soda softening process.

In 1985, 8 inline pressure filters were installed and the raw water source was changed from Pykes Creek Reservoir to Merrimu Reservoir. Merrimu had thus far been a water source of good quality, being low in colour and turbidity. When the pressure filters had been commissioned, the majority of the original plant was de-commissioned; still in use are clear water pumps, limil, fluoride and disinfection facilities.

Decision time is approaching as to wether the Bacchus Marsh plant is substantially upgraded or whether Merrimu plant is upgraded to supply Bacchus Marsh with the Bacchus Marsh plant being de-commissioned. Upgrades at the Bacchus Marsh plant would be substantial, as during peak demands, "shandying" of raw and final water is required; maximum plant output is 10ML per day whereas demands in excess of 15ML per day now exist in summer.

1.0 INTRODUCTION

During the Christmas/New Year period of 1999, the Merrimu catchment received heavy rainfall, ensuing inflows to the catchment resulted in turbidity of 100 ntu and colour of 150 tcu. This drastic reduction in water quality seemed to be caused by development in the upper catchment, low reservoir level, drought conditions, logging and possibly a large dam burst that had been built across a tributary.

At the Bacchus Marsh WTP there is a 40 ML raw water basin, which is filled from Merrimu Reservoir, the plant then draws water from this basin for treating. Within a week of the fore mentioned rainfall, the basin represented the same quality water as in Merrimu Reservoir. A succession of operational problems then took place.

2.0 EXISTING PROCESS

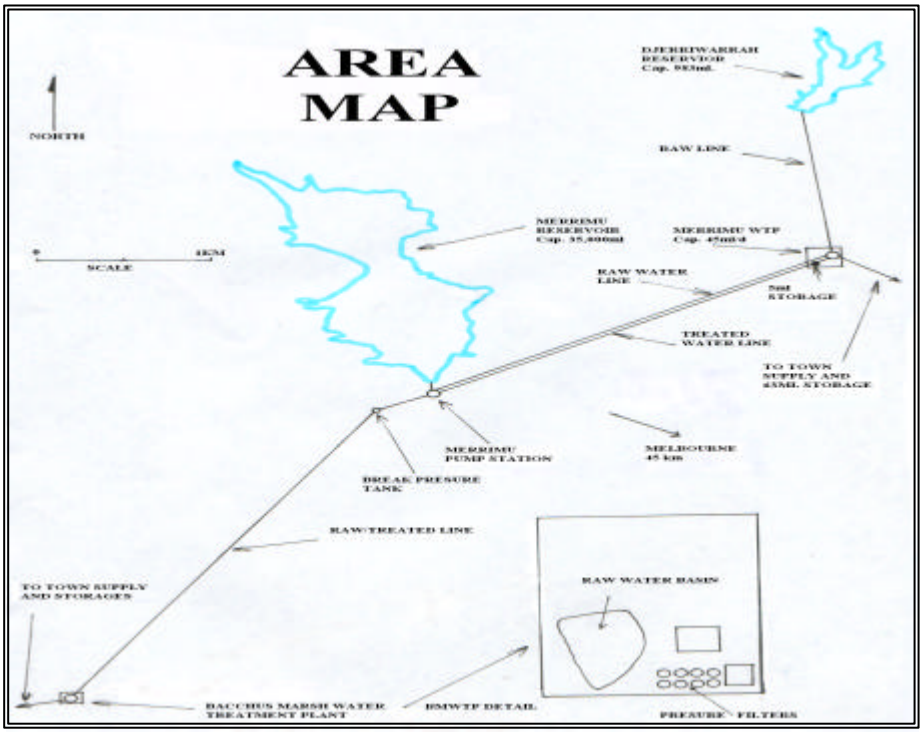
The pressure filters at the Bacchus Marsh WTP are only capable of treating moderately turbid and

coloured raw water. Timers or turbidity set points initiate filter backwash; previous to the poor raw water quality, we had filter run times of up to 24 hours. Afterwards, despite numerous jar tests, we had filter run durations measured in minutes.

2.1 Previous Works

In 1997/98, a 4km pipeline was installed from the Merrimu WTP to the Merrimu pump station. Prior to this, a 5 ML clear water tank had been constructed. This new pipeline is connected to the tank, and flows from it to Bacchus Marsh, via the Merrimu pump station and break pressure tank (by gravity flow)

Figure 1: ***Area Map***



2.2 Problems at the Merrimu WTP

The Merrimu WTP treats water for Melton and smaller outlying areas. These previously mentioned works were enabled so that the Merrimu plant could supply water to Bacchus Marsh during the cooler months via the 5ML storage, although this tank was initially built as a replacement for an undersized high-level area supply.

At this stage we initiated supply of Bacchus Marsh from the Merrimu plant. Thankfully, we were into lower demand times, as the Merrimu plant doesn't have the capacity in peak demand times. Although easily able to treat this quality raw water, the extra demand/output was marked by a large increase in sludge output.

A decision was made to construct 1 large new sludge bed and install under drains in some of the other sludge beds, which didn't have them. During these civil works, we had to move the excess sludge off-site by tanker. The Merrimu plant kept supplying Bacchus Marsh for some time, during which time the raw water quality did improve, but when peak demand times returned, the Bacchus Marsh plant had to be brought back on-line.

3.0 THE NEXT STEP

For a time, the Bacchus Marsh plant was able to maintain filter run times of 2-4 hours, until the Merrimu Reservoir received further inflows, thus increasing both colour and turbidity. In addition

to this, and as a result of Merrimu catchment volume increase, the Authority had decided to lift the water restrictions that had been imposed 3 years previous.

We then had only one option, which was to pre-treat the raw water at the Bacchus Marsh plant basin. Although not happy with the possible eventualities, we set up Alum dosing facilities with an injection point on the incoming raw water line. Initially we had problems with inadequate mixing, but this was overcome with makeshift in-line mixers installed within the pipe.

After a few days of processing the raw water, enough turnover had occurred and clarification became evident. Initial dosages of 100 mg/l were reduced to 80 mg/l and later 60 mg/l. The raw water basin now acted as a giant clarifier and was performing 90% of the treatment process.

Table 1: ***Raw water characteristics***

Parameter	Merrimu Raw Water	Raw Water Basin – Alum treated, pre-filtration
Turbidity (NTU)	100	1.4
Colour (TCU)	150	5
pH	7.4	6.6
Alum Residual (mg/L)		0.01

Water was then drawn from the basin and passed through the filters with small dosages of alum and polyelectrolyte added to assist in "polishing".

The resulting turbidity (0.4 NTU) enabled Bacchus Marsh residents to enjoy water clarity like never before. Four months passed, after which, taste and odour problems occurred.

Figure 2: ***Pressure Filters***

Figure 3: ***Raw water basin (partially emptied)***

4.0 TASTE AND ODOUR PROBLEMS

Taste and odour problems commenced in late December 2000, they were earthy/musty/grassy in description. It was soon concluded that the problem emanated from the raw water basin. Working against us was the fact that the basin had not been cleaned since being built nearly 50 years ago. The clarification within the basin also compounded all organic matter to the base of the storage, this in turn allowed sunlight to penetrate deeper into the water column, this causing additional problems in itself.

4.1 Initial control measures

We ceased chloramination and commenced chlorination at an increased dosage, hoping that this would "Mask" the taste and odours. In addition to this, we carried out extensive system flushing.

Our next step was to install various forms of aeration; this was done in an attempt to liberate volatile components causing the taste and odours. At first, aeration was carried out in the 15ML clear water storage and, although the results were noticeable, we decided to move the aeration process closer to the source. Aeration facilities were then set up within the raw water basin and the clear water contact tank located at the Bacchus Marsh plant, results from here seemed more favourable.

During these initial stages, WSL Consultants Pty Ltd and Microcosm Consulting Pty Ltd were employed to assess, quantify and advise on the problems.

4.2 Divers

From our conclusions and Consultant recommendations, we employed the services of Nordic Diving Services. The divers spent a few days carrying out various tasks:

- Vacuuming around plant intake lines
- Changing plant "shandy" line to another re-commissioned point (old plant inlet), which drew water from high water (floating take-off)
- Re-configuring of main plant inlet (raised take-off point 1mt)
- Optimising placement of aeration manifolds

4.3 Results

WSL and Microcosm had been analysing samples from the onset of taste and odour problems. The works carried out had resulted in an improvement in measured values, although, the effectiveness of the aeration was deemed minimal, so this ceased. Organic analysis of the water

revealed significant concentrations of Geosmin and Trichloroanisole (TCA) well in the excess of the human taste thresholds of 5-10ng/L respectively. The actual source of these taste and odour compounds in the basin was difficult to pinpoint as a number of organisms such as algae, fungi and bacteria can produce these compounds that cannot be used immediately or stored. Anecdotal evidence suggests that the blue green algae, *Oscillatoria splendida* may have been the source of the taste and odours in the basin due to its abundance and its well known credentials as a nuisance organism that produces taste and odour problems.

The Consultants then recommended the next step of using G.A.C (Granular Activated Carbon) to combat the problem.

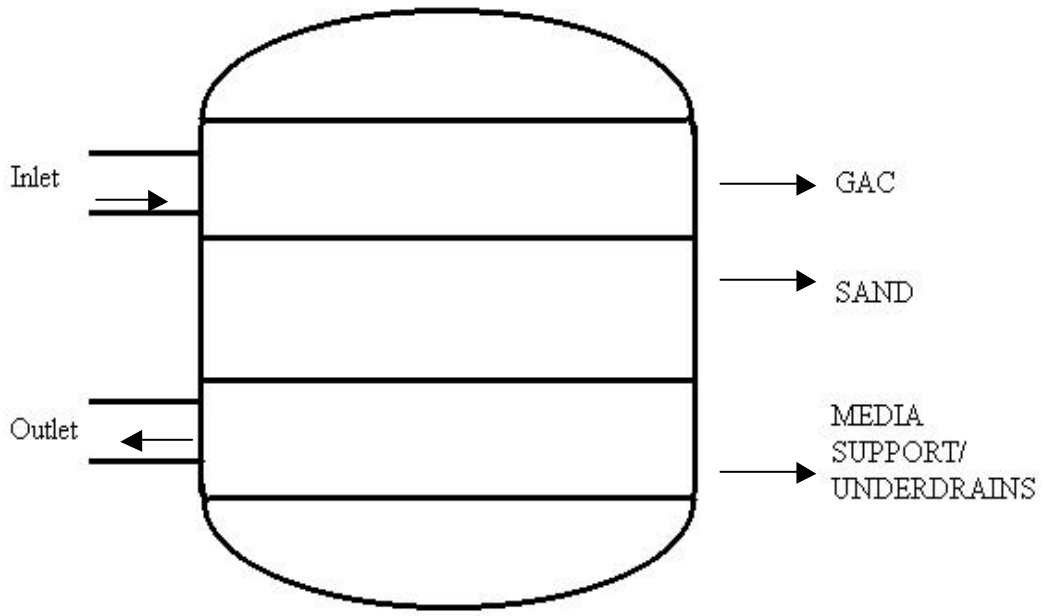
5.0 TRIALING OF G.A.C

WSL Consultants under took lab trials of G.A.C, using water from the raw water basin. The tests showed that the G.A.C would be effective in removing the tastes and odours. Operators were then involved in removing filter media samples and measuring their depths.

It was decided to go ahead and replace the Anthracite within one secondary filter to fully test the viability of the G.A.C. In late March 2001, this process was undertaken. This involved an initial soaking period to saturate the carbon, then "Conditioning" of the filter took place, during which, back wash rates were measured and backwash waters analysed for carry-over.

For the first two weeks of operation, we reduced the backwash rate due to excessive carry-over of G.A.C. A further inspection of the filter bed found the underlying sand was not being cleaned properly at this backwash rate. We then decided to backwash at normal rate and found carry-over not to be excessive and to be further reducing at each backwash.

Figure 4: ***Filter cross-section***



Final analysis from filters with G.A.C reflected lab simulations. The addition of G.A.C in this application proved to be a very successful method of removing the taste and odour.

The cost of product for this application was $3000 per filter (1000kg). Media life is expected to be 6 to 18 months, at which time it would need to be replaced or re-generated.

Table 2: ***Taste and odour analysis***

PARAMETER	RAW BASIN	POST G.A.C.FILTRATION
M.I.B ng/l	<4	<1
Geosmin ng/l	* 3	<1
T.C.A ng/l	<0.02	<0.02

* Earlier readings were as high as 42.

Note…G.A.C also reduced TOC (total organic carbon) from 6.0mg/l to 4.9mg/l

Hopefully, the next step, being the cleaning out of the raw water basin and an improvement in raw water quality, will negate the use of the Alum dosing to the basin to pre-treat the raw water and thus stop the progression towards taste and odour problems. In the event that we did have to revert to Alum dosing, hopefully with the basin having been cleaned out, it may take some time before it reaches a point, which is conducive to taste and odour production.

The G.A.C would provide a solution if this did happen. Unfortunately, a problem will arise when shandying, as the shandied water bypasses the filters and G.A.C.

6.0 CLEANING OF THE RAW WATER BASIN

The major task of cleaning the raw water basin was then undertaken. At the end of April 2001, the Bacchus Marsh plant was shut down, Bacchus Marsh Township being supplied with water from the Merrimu plant, and the basin draining to waste commenced. Steve McKenzie Consulting was employed to oversee the procedure and Tenders were invited to carry out the clean out.

On site disposal of the removed sludge will be possible as we have cleaned out a number of old sludge beds and carried out civil works to allow the possibility of pumping liquid sludges to these beds or to the sewer.

7.0 CONCLUSION

At the submission of this manuscript, the basin clean out contract had not yet been awarded. At the moment there are two preferred tenders. One will use mixers / aerators / pumps to de-sludge the basin. The other contractor will use mechanical means being similar to the clean out of a large farm dam. The latter would provide a more comprehensive sludge removal, but there are noise issues, considering a time estimate on the job of 3-4 weeks.

There has been an improvement in raw water quality with colour of 85 tcu and turbidity of 12 ntu, although there is still a high probability that we will have to pre-dose with alum. When we initially started dosing with alum, only 4 ½ months passed prior to the onset of taste and odour problems.

Probably, the basin had considerable sludge build-up prior to our alum dosing and this was the catalyst to taste and odours.

We are hoping that having the basin cleaned out will allow us to run the plant for longer than 4 ½ months without taste and odour problems. Management should have then decided which plants will be upgraded or perhaps they will re-visit a pipeline connection to our reticulation from Melbourne Water to supplement our supply. Consideration throughout the project was given to the requirements of the customer charter and business plan targets and as always, with these processes the customers were kept informed and the operators involved at each step.

8.0 ACKNOWLEDGEMENTS

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