MONITORING WATER TREATMENT PLANT PERFORMANCE IN AUSTRALIA - ARE WE GOOD ENOUGH?

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ABSTRACT

The need for long term monitoring of filter performance is presented along with data from a number of Australian WTPs. The data is bench marked against similar data from the US Partnership for Safe Water (PfSW). The reader is left to decide for themselves whether the performance of our Australian plants represented by the graphs is acceptable.

1.0 BACKGROUND

Our primary responsibility in the water industry is to produce safe drinking water, water that doesn't make the consumer ill. Steve Hrudey, a Canadian researcher, concluded after studying waterborne disease outbreaks in the developed world that pathogens were the major risk and that all water treatment should be focussed on management of pathogens. And for many years now *Cryptosporidium* has been the major pathogen of concern, and responsible for the majority of water borne illnesses.

The Australian Drinking Water Guidelines (ADWG) are just that, guidelines and not regulations. While there are a number of Safe Drinking Water Acts (SDWAs) in different states, we have no real regulations in this country. Our ADWG and the various SDWAs promote a risk management framework for their management but provide no real guidance as to how to achieve adequate or best practice management. Risk management plans produced by utilities are really only as good as the water quality and public health knowledge within the utility and this quite frankly is often lacking. The Australian approach contrasts with regulations in countries such as United States and New Zealand. It is an interesting commentary that in the absence of our own regulations, a number of Australian utilities in fact embrace the US regulations (notably the ESWTR LT2 rule).

This paper presents data from Australian plants and should be read in conjunction with the paper presented by Jason Colton describing the NZ system, its regulatory environment and the impacts this has had on water treatment and drinking water safety in that country.

1.1 Pathogens, Turbidity and Monitoring of Turbidity

We cannot measure pathogens on line yet. And indeed we cannot easily measure many of them regularly in samples. Our only real process monitoring parameter is turbidity which can be measured on line and provide instant feedback to facilitate immediate process control changes when required.

Studies have shown that to achieve even reasonable removal of *Cryptosporidium* you need to achieve better than 0.2 NTU from every filter at all times. Even then removal may be quite poor (<2 log). In general, the lower you get the turbidity below 0.2 NTU the lower the risk to public health. In simple terms, turbidity equals pathogen risk. To minimise pathogen risk, minimise turbidity.

Most operators and operations management would be familiar with standard monitoring of SCADA trends typically viewed over a few hours to a few days (Figure 1), but most are not familiar with longer term monitoring and the advantages such analysis offers (Figure 2).

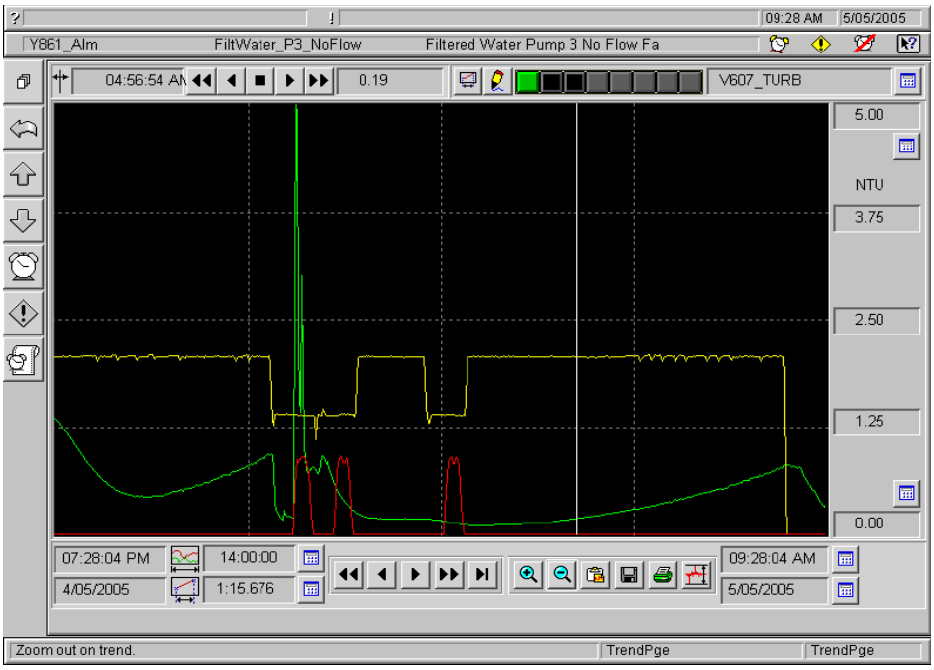

Figure 1: ***An example of short term WTP monitoring showing plant inflow (yellow), filtered water turbidity (green) and backwash flow (red).***

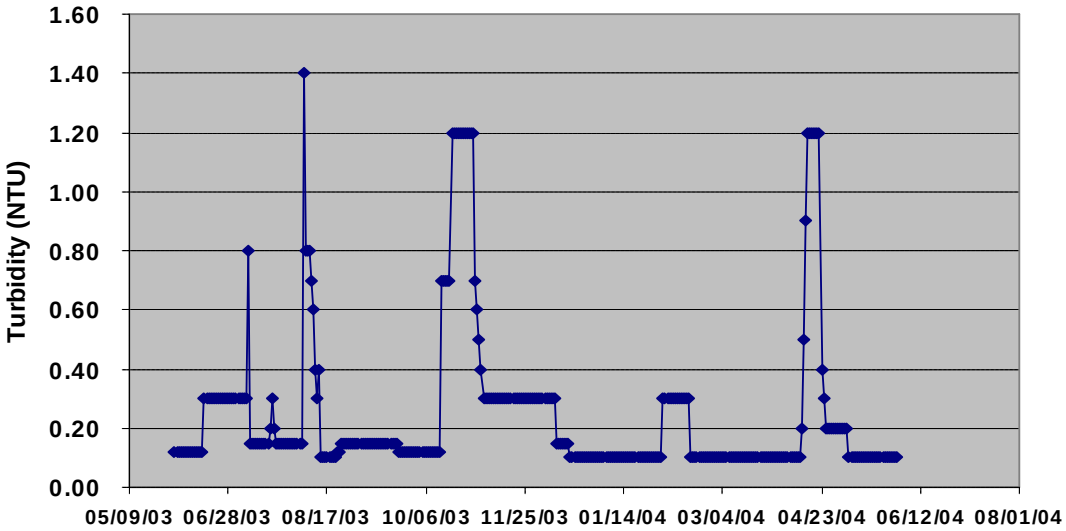

Figure 2: ***An example of a long term, time series presentation of WTP performance showing periods of good performance and periods of poor performance.***

Time series data should be collected to allow comparison of raw water turbidity, clarified water turbidity and filtered water turbidity over the same time period.

At a minimum these data should be analysed over a period of several months however at times, analysis over periods as short as two weeks can be instructive. These time series can then be used to try to determine causes of any periods of poor filter performance and bring about improvements in the operation of the plant to prevent them recurring.

Figure 3 shows data from a WTP where the raw water turbidity increased slightly from around 2 NTU to around 8 NTU (not a very big increase!). Figure 4 shows the filtered water turbidity for the same period. Clearly the plant had trouble coping with the increase in raw water turbidity even though it was quite small. The plant was a direct filtration plant which highlights some of the limitations of such plants; however there is no real reason why a direct filtration plant should not be able to cope with a raw water turbidity event of this size. Clearly such information can allow the utility responsible for the plant to focus on what needs to be done to prevent such deterioration on filter performance in the future.

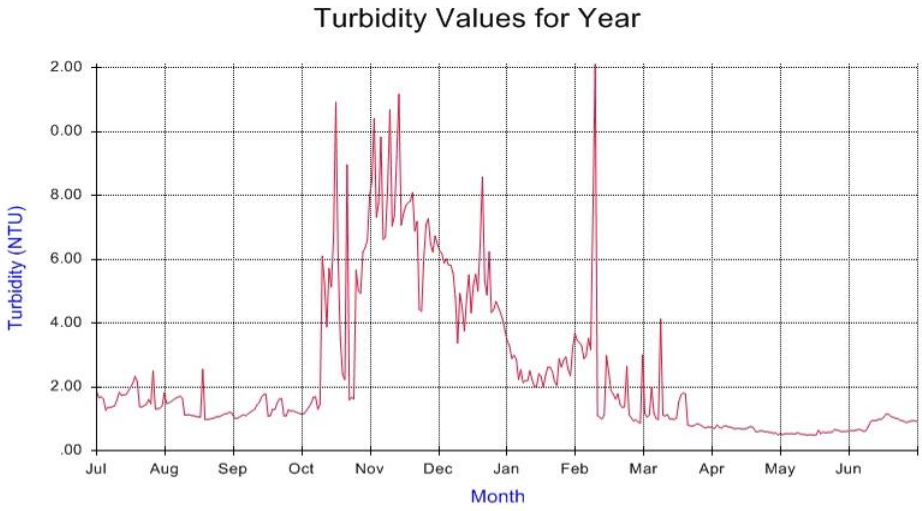

Figure 3: ***Raw water turbidity time series data for a 12 month period showing a lengthy period where turbidity is elevated above the background level.***

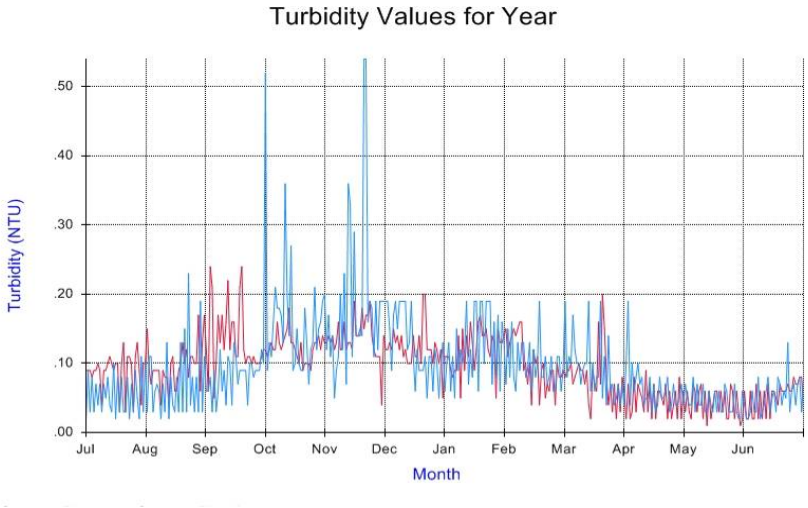

Figure 4: ***Filtered water turbidity for the same 12 month period as shown in Figure 3.***

Long term monitoring data can be presented in different ways to allow alternative interpretation of the data and what action is required.

A convenient way of representing plant performance that allows easy comparisons between filters and between plants is the cumulative frequency plot. These show the percentage of time that a plant/filter is producing water less than a particular turbidity. Figure 5 shows an example.

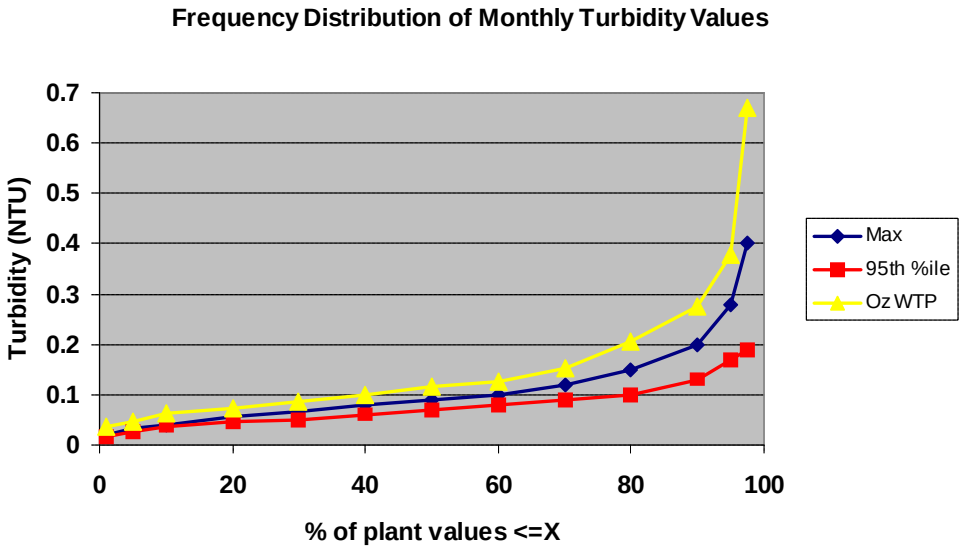

Figure 5: ***Cumulative frequency representation of an Australian WTP compared to Partnership for Safe Water bench mark performance.***

In Figure 5, the blue (middle) line is the 100th% ile line from the US Partnership for Safe Water (PfSW) data. This means all the participating US plants (over 400) were better than this line. The red (bottom) line is the 95th %ile. This means that 95% of the participating plants were better than this. Clearly the Australian plant is not performing very well compared to this data. From the yellow (top) line it is possible to see that the Oz WTP is only achieving <0.1 NTU 40% of the time and <0.2 NTU (The new ADWG limit) 80% of the time. Clearly room for improvement!

In simple terms if the line is above the PfSW lines, plant performance is poor. If it is below the lines performance is better. The lower the line the better. Figure 6 and 7 show examples of very good performance and "lousy" performance.

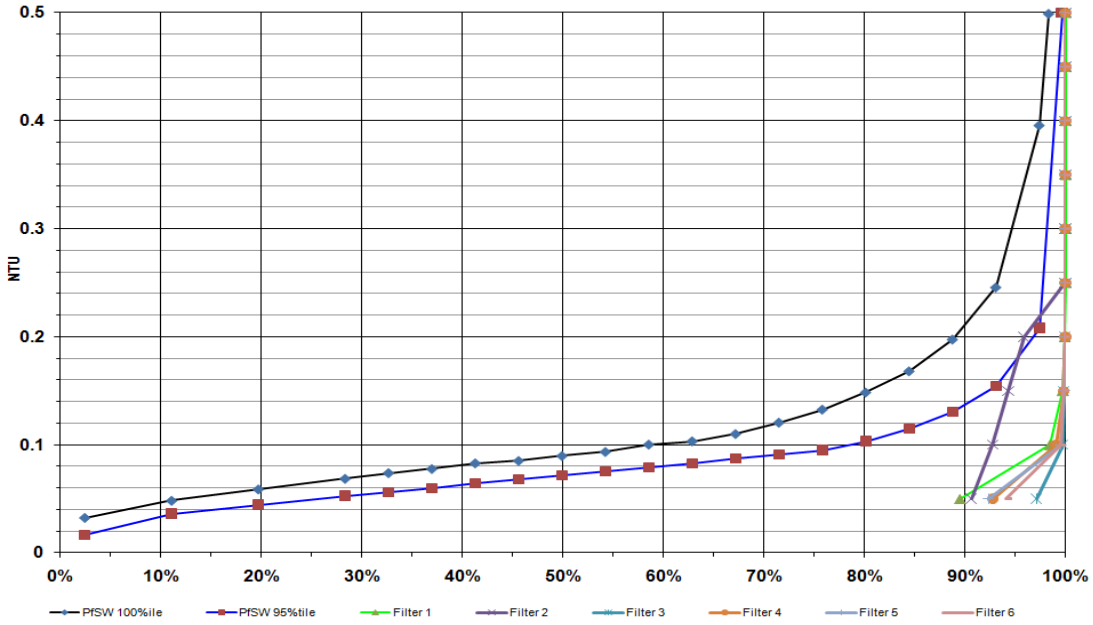

Figure 6: ***Very good performance, but look closely, the data is good enough to show that one of the 5 filters is not performing as well as the others.***

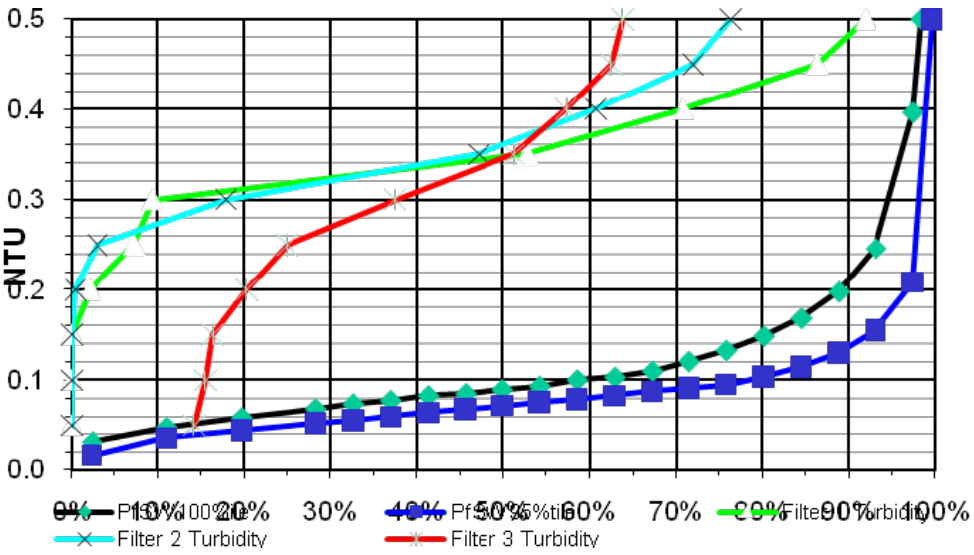

Figure 7: ***Lousy performance***

Figure 8 shows times series data for a large WTP where stable operation is never really achieved. Another way of interpreting the trend is to conclude that the ripening period is very long, several days!

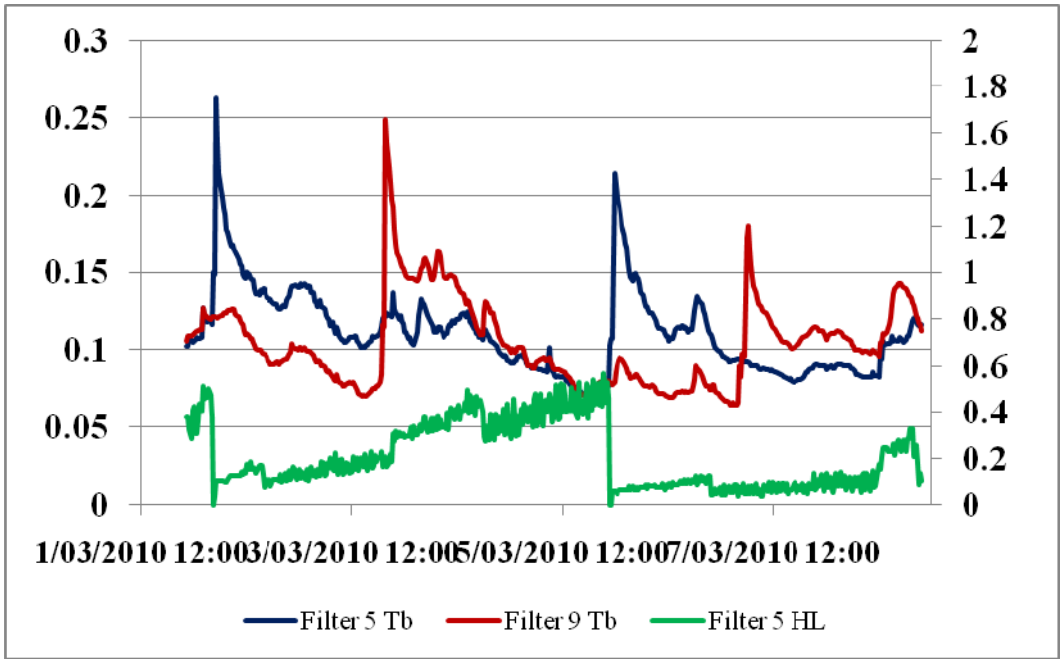

Figure 8: ***Time series data over a 10 day period showing that the filters never actually achieve stable operation and the "ripening period" is very long. The red and blue lines are turbidity data for 2 filters and the green (bottom) line is the head loss data for one of those filters.***

Additional data will be presented for a number of Australian WTPs. The plants range from capital city plants, to regional city plants, to plants with significant food industries in the town and to cities with a major tourist industry. It is left up to the reader to draw conclusions about the quality of the water. (The data presented here should be compared with the paper presented by Jason Colton describing the New Zealand situation.)

SO, are we good enough? You decide.

Bottom line is all Australians deserve safe drinking water!

Is your plant performance good enough? Find out.

Note. An *Excel* based software package that allows data analysis of this type (and more) will be available through Victorian Department of Health and WSAA later this year.