

RELIABLE RAW WATER QUALITY, DON'T TAKE IT FOR GRANTED

Shawn Charlton, *Supervisor Water Filtration & Pumping*, Albury City Council

ABSTRACT

AlburyCity considers itself very lucky, as it has 3,005,156 megalitres of raw water storage (The Hume dam). As a result, raw water quality issues are few and far between. However, this all changed on February 19th, 2021. AlburyCity began to receive customer complaints regarding black/brown water. The number of complaints steadily increased and peaked 3 days later on the 22nd February, and we were still no closer to finding the cause. The complaints were not centralised to a particular part of the city and no link could be established between the complaints and a single reservoir, water main or pressure zone. Other water users, including our neighbour Wodonga hadn't noticed any issues with their potable network.

Over the following days it became evident that there had been a substantial change in the water quality being discharge from the Hume Dam. This caused a significant impact on water quality for downstream customers and the environment. The changes included a substantial drop in dissolved oxygen (DO) and considerably elevated concentrations of iron and manganese following the recent bush fires and high levels of stratification within the Dam. These elevated concentrations of metals subsequently ended up precipitating out in the city's reticulation network, giving rise to the aesthetic complaints.

Following this event, it was the aim of AlburyCity to be able to identify and react to similar events in the future in a more proactive way. For this to occur AlburyCity needed to increase communication pathways with state government departments, increase raw water monitoring as well as installing additional chemical dosing equipment.

1.0 INTRODUCTION

Albury is located in South Eastern New South Wales and borders on the Murray River. AlburyCity is the Local Water Utility (LWU), who supply water to over fifty five thousand residents. This water is sourced from the Murray River, with the primary offtake being 5 kilometres downstream of Hume Dam wall.

Hume Dam has a storage capacity of 3,005,156 megalitres and has historically been a reliable source of water, both in terms of quality and quantity. Raw water quality has some seasonal variations with the most notable being Blue Green Algae (BGA) in the summer months, but overall, the quality is considered stable. It is well documented that Hume Dam does stratify into two layers over the summer months. Known as the epilimnion (oxygenated) and hypolimnion (deoxygenated). Although in the past this had not resulted in any notable change in water quality for downstream users.

On Friday 19th of February 2021, AlburyCity began to receive a higher than usual number of customer complaints regarding brown or black water. Complaints of this nature are uncommon in Albury and are usually associated with a nearby mains break, or construction works. What made these complains unusual was the high number (11) and that they were distributed across the entire water reticulation system (Figure 1). AlburyCity responded to these complains by flushing selected water mains and reviewing recently analysed water quality data. The data which had been collected a month previous showed no change in any parameters including iron and manganese. Council also contacted North East Water

(NEW) who provide water and sewer services to Wodonga, located on the Victorian side of the Murray River, to determine if similar observations had been noticed. The response back from NEW was that they were not experiencing any notable increase in discoloured water, nor did they receive any customer complaints. Considering all of the available information at the time AlburyCity entered into the weekend with the mind set of continuing to monitor the situation and action where required.

The number of complaints continued to rise throughout the weekend (although not registered in the AlburyCity’s Customer Request System) peaking at 52 complaints on Monday the 22nd of February (Figure 2). By this stage AlburyCity had allocated significant resources to determine the underlying cause of the discoloured water.

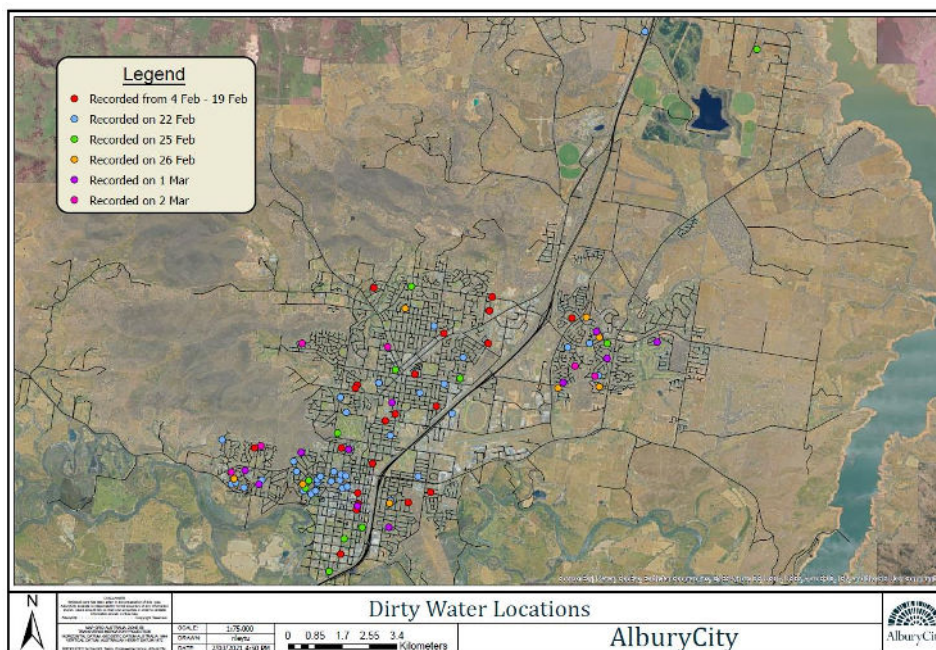


Figure 1: *Customer complaints of discoloured water*

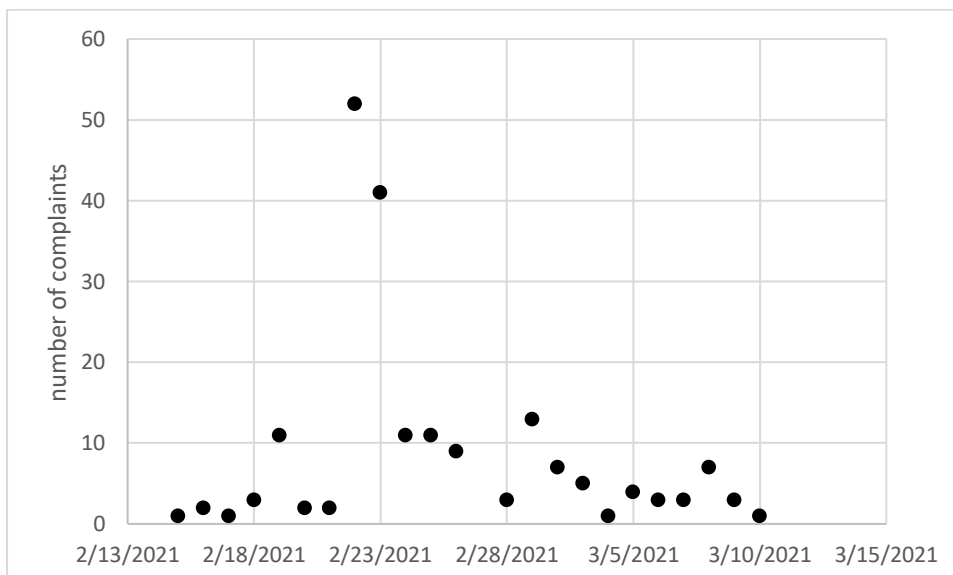


Figure 2: *Customer complaints of discoloured water*

Council received a redirected email on the morning of Tuesday the 23rd. The email had been written by a contractor who at the time was working for the Murray Darling Basin

Authority (MDBA). After being passed around a number of times to different organisations in Victoria the email was finally received by AlburyCity. The email explained that due to a number of uncontrollable factors the water being released from the Hume Dam was low in oxygen and high in dissolved metals like iron and manganese.

This explanation fit perfectly with what Albury City was experiencing. The Hume Dam operators noted on the 17th of February that Murray Crayfish *Euastacus armatus* were leaving the water and crawling up the riverbanks along with a notable strong sulphur smell. This was observed 2 days before complaints of discoloured water started. Mitigating measures were implemented at the dam on the 22nd which saw dissolved iron and manganese concentrations decrease in line with customer complaints.

2.0 DISCUSSION

AlburyCity's timeline for this event originally started on the 19th of February, when in fact the true timeline stretches back several weeks. In the summer of 19/20 large bushfires burnt in the Upper Murray catchment. As a result of these fires and during a series of substantial rainfall events between October 2020 and early February 2021 (Figure 3) large amounts of organic carbon and sediment were washed into the Murray River. Dissolved organic carbon concentration entering the Hume Dam peaked twice, once in October 2020 and again in February 2021.

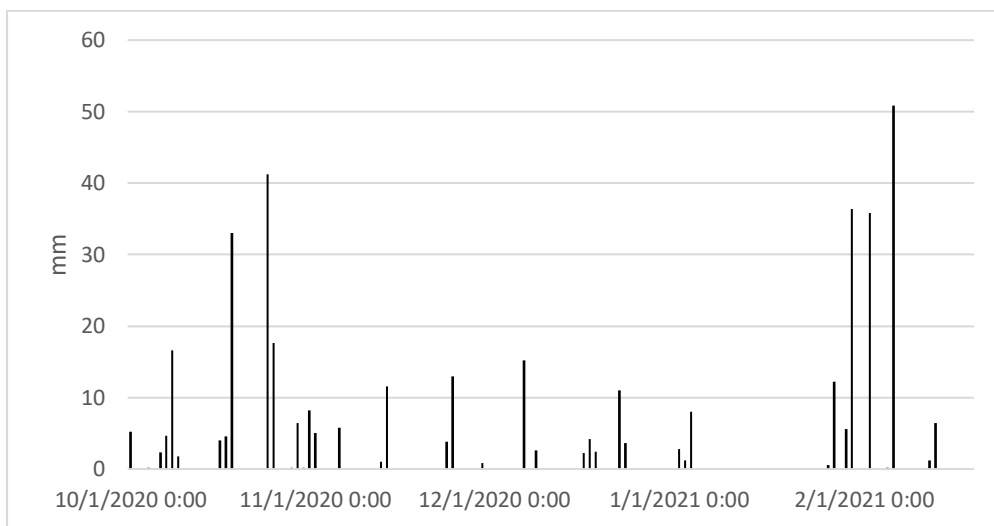


Figure 3: *Daily rainfall totals at Jingellic*

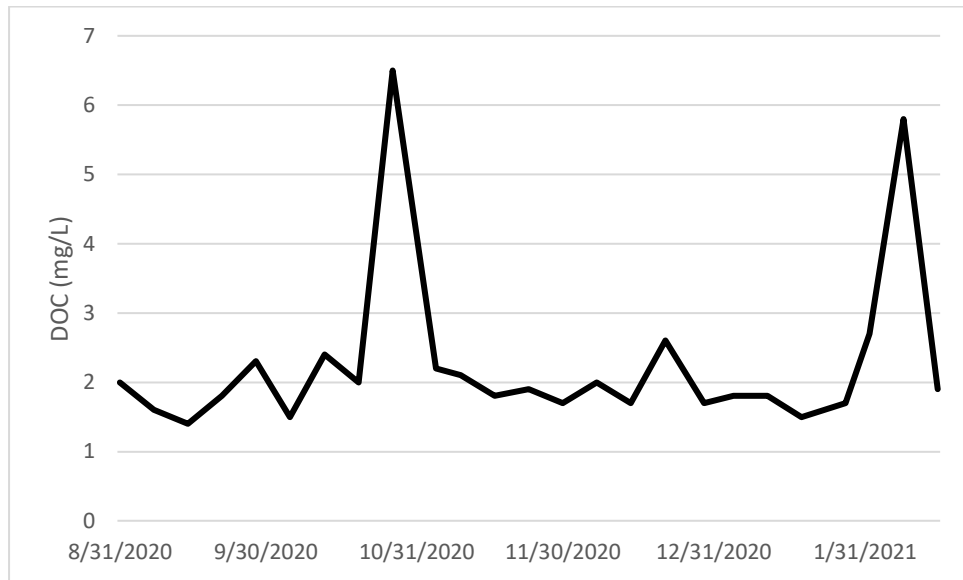


Figure 4: *Dissolved organic carbon concentrations at Jingellic*

These repeat high organic carbon loads increased the anaerobic respiration in the deoxygenated hypolimnion zone, leading to elevated concentrations of dissolved iron and manganese (Figure 5). When this water was then discharge from the Hume Dam and into the Murray River there was insufficient dissolved oxygen and/or time to convert all of the dissolved iron and manganese into an insoluble form. The remaining dissolved metals were then drawn into AlburyCity’s water network, causing the discoloured water complaints.

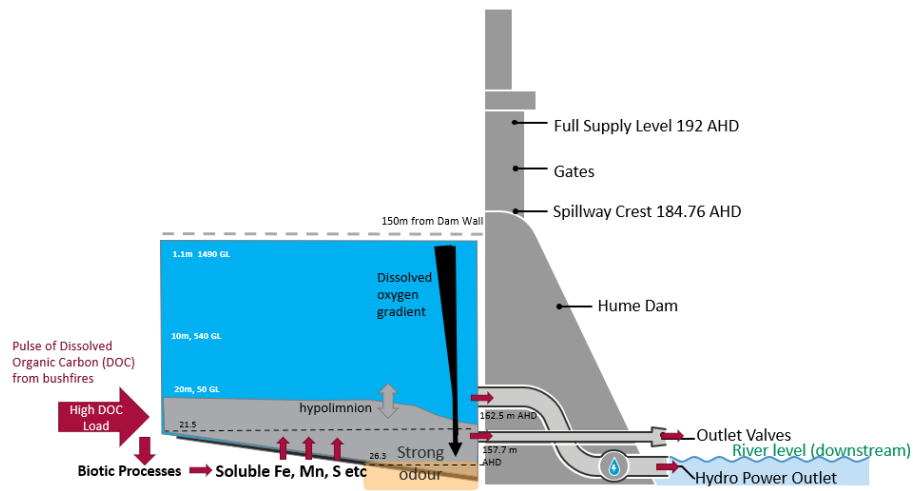


Figure 5: *Cross section of Hume Dam (Diagram supplied by MDBA)*

3.0 FUTURE MEASURES

AlburyCity’s response to this event could be characterised into three key categories:

- Foster relationships and increase communications with catchment authorities;
- Review and expand Councils Water Quality Monitoring System (WQMS); and
- Installation of pre oxidation equipment in the treatment processes.

These three categories combined would place AlburyCity in a much more advantageous

position for future raw water quality events.

Fostering Relationships

It became evident in the following days, weeks, and months that it would be in AlburyCity's best interests to forge greater relationships with the operational managers of the Hume Dam, The Murray-Darling Basin Authority (MDBA). A working group was formed shortly after which included a number of key stakeholders including AlburyCity. This working group has been actively collaborating throughout early 2022 identifying changes before any potential issues arise. Prior to this event, Hume Dam operators were making decisions on the operations of the dam without realising the impacts this could have on downstream local water authorities. I would like to acknowledge the MDBA on their initiative to form the 'Lake Hume Low DO stakeholder group' which has been meeting frequently throughout the high risk period to ensure trends are monitored and all stakeholders are well represented, and our needs are clearly voiced to address arising issues in unison.

Review of Water Quality Management System

A review of the Council's WQMS did identify areas in which monitoring could be expanded. This expansion would give the Council a much more wholistic and complete view of the water quality from catchment to tap. One fundamental consideration when entering into the review process was to consider all possible water quality events which could occur, not what has occurred in the past. Council did not want to fall into the trap of interpreting that having a reliable raw water source meant that raw water quality would never change.

Council engaged with Hunter H2O to assess short term manganese removal treatment options. Three broad treatment options were considered:

- Pre-chlorination dosed into raw water
- Pre-chlorination dosed into DAF subnatant (oxide coated media)
- Potassium permanganate dosed into raw water

Pre-Oxidation

Pre-chlorination was selected, and a sodium hypochlorite dosing system was installed at Council's raw water pump station. This option was preferred due to its ease of operation, installation time and its effectiveness in oxidising manganese. The system does have limitations such as disinfection by-product (DBP) generation and limited or no use during blue green algae blooms. Real world data from a recent high manganese event has validated Council's decision to install a pre-chlorination system. The event saw manganese concentration in the raw water increase rapidly to 0.19 mg/L with the majority of this being dissolved. The pre-chlorination system was activated which successfully oxidated the majority of the dissolved manganese to an insoluble form.

4.0 CONCLUSION

For AlburyCity this event was unforeseen, and unheard of. We now recognise that this event could have been identified in the weeks before the 'incident' and we have learned that:

- The vigilant monitoring of localised raw water quality, and the wider catchment, is critical in ensuring safe and aesthetically pleasing drinking water.
- Local Water Utilities (LWU) should avoid the traps of assuming that the Catchment Regulators are aware of their needs, and that historically-reliable raw water sources

are unable to have significant water quality events.

- Vigilance is key - expect the unexpected.
- Use the experiences that other LWU's have had to shape your raw water quality monitoring system. If other LWU's have had past events (like high manganese, high DOC or taste and odour issues), don't assume that similar events won't happen to you. Make your position and requirements clear to Catchment Regulators and foster strong relationships that have open and transparent lines of communications.
- Monitor your catchment, a good monitoring system is much more than just sampling at your offtake or reservoir. Pay attention to critical upstream indicators. There is a multitude of easily accessible, good, reliable, up to date data on government websites.

4.0 ACKNOWLEDGEMENTS

I would like to acknowledge the hard work and assistance of many people who helped pull this paper together. Particularly the wonderful people in AlburyCity's Water and Wastewater department, Heidi Josipovic, Chris Murphy, Brad Willis, Greg Whorlow and Adam Carty. I would also like to acknowledge the last minute assistance of Craig Hardge from the MDBA and Darren Baldwin from Rivers and Wetlands.

5.0 REFERENCES

State Government Victoria, Department of Environment, Land, Water & Planning *Rivers and Streams/ Surface Water Sites/ 401 Upper Murray Basin/ 401201 Murray River @ JINGELLIC*
<https://data.water.vic.gov.au/>

Civardi J Tompaeck M. *Iron and Manganese Removal Handbook*. American Water Works Association

Hardge C. *Lake Hume & River Murray Low Dissolved oxygen Event February 2021*

Pearce L Watson M Baldwin D Doyle K Baumgartner L. *long-term effects of the 2019-20 bushfires – water quality and Murray crayfish Lateral Lines* June 2021