

Blue-Green Algal Blooms

Operational management to address algal risks for
Water Treatment Plants



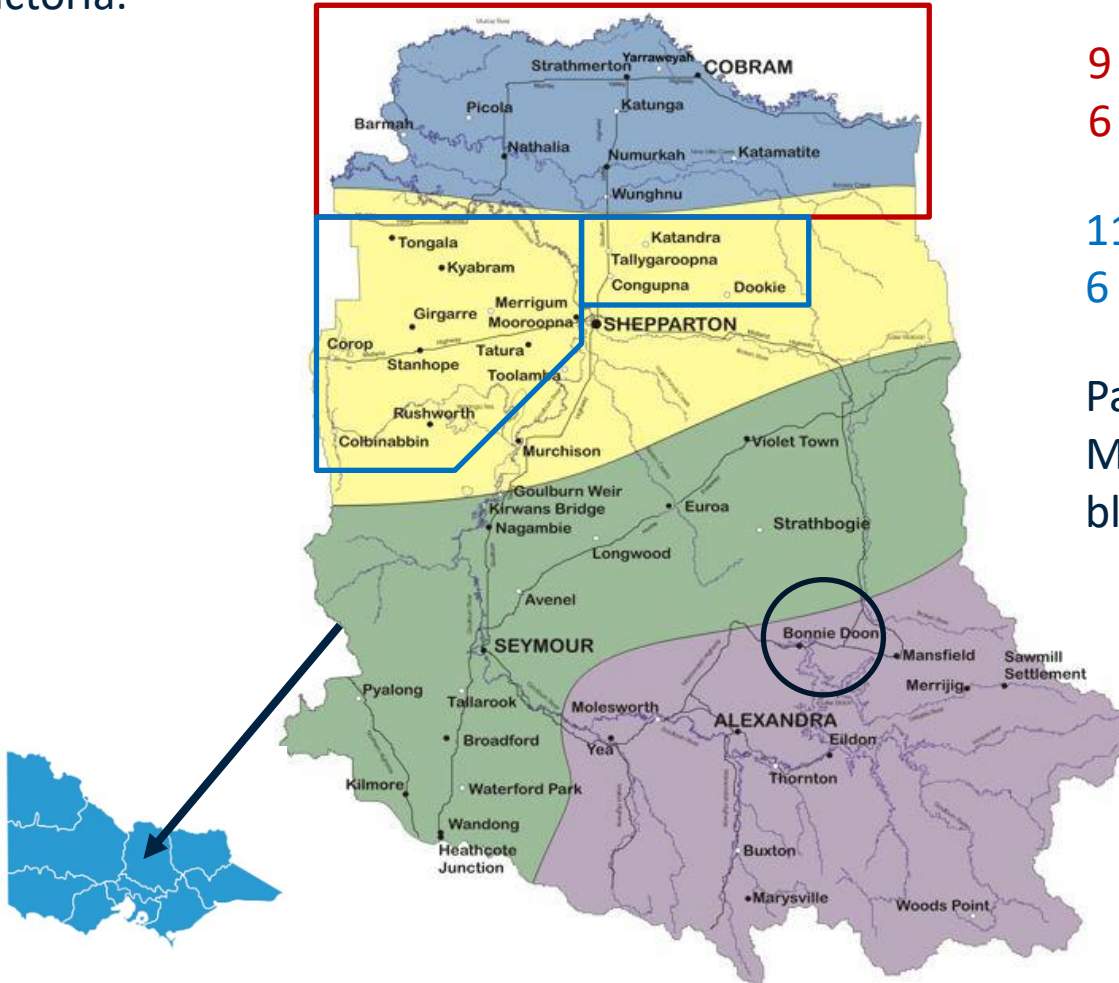
- GVW
- ADWG
- Source Water
- Powdered Activated Carbon
- Conventional Treatment
- Sludge Management
- Disinfection / Oxidation
- Still Concerned
- Conclusion



Goulburn Valley Water



GVW provides water and wastewater services to a population of 125,000 in 54 towns connected to 37 water supply systems and 26 wastewater management facilities in Northern Victoria.



9 Towns (6 WTPs) subject to 6 month bloom 2016

11 Towns (10 WTPs) subject to 6 month bloom 2017

Past history of blooms along the Murray River and short term blooms in discrete localities

Bonnie Doon Raw Water Storage Bloom duration 2 years, 9 months, 17 days (1021 days, 2015 – 2018)

MICROORGANISMS Cyanobacteria and their toxins

Information for drinking water utilities found in the ADWG fact sheets



Australian Drinking Water Guidelines 6, 2011 p.324

The right combination of water treatment processes can be highly effective in removing both cyanobacterial cells and toxins, but may require modifications to standard operations.

Australian Guidelines



- When assessing blooms and the risk to drinking water, a tiered framework should be considered
- Depending on State regulations & directives, initial notification to health authorities could be provided when biovolumes reach 1/3rd of the health alert level
- For *M. aeruginosa* this notification is equivalent to a biovolume of 0.2 mm³/L. (alert 0.6 mm³/L)
- *In general, cell counts are undertaken on raw waters. Health Authorities may not require this notification unless the water containing this level of contaminates is actually supplied to the consumer. Check your regs.*
- *However the tiered levels should be considered when assessing the risk to treatment and the need to apply further controls or undertake toxin analysis. What happens when the biovolume is 0.6, 2, 4, 10, >20?*

What about Non-toxic
species?

PHYSICAL AND CHEMICAL CHARACTERISTICS –
FACT SHEETS

Taste and Odour

Australian Drinking Water Guidelines 6, 2011 p.930

Guideline: *The taste and odour of drinking water should not be offensive to most consumers*

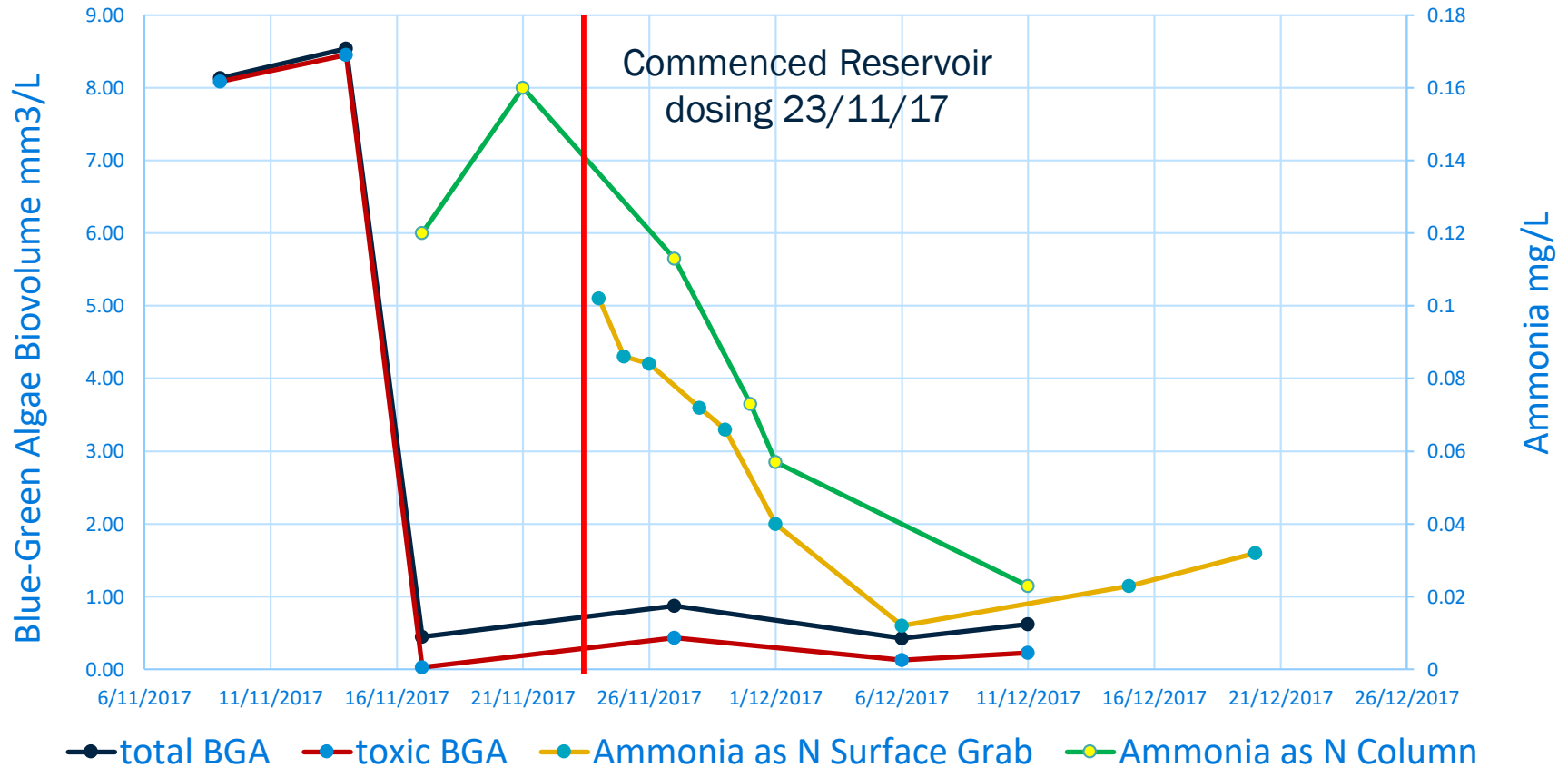
Regardless of toxicity, taste and odour compounds MIB & geosmin (earthy, musty & woody smells) could be present at very low cell counts

There may also be an increase in DOC which could impair your disinfection.

The release of **ammonia** may follow the collapse of *Chrysochloris* blooms and could result in finished water **smelling like a toddlers wading pool**.

Ammonia release

Numurkah Raw Water Storage [200 ML]
Impact of collapse of *Chrysochloris Ovalisporum* Bloom



Is there anything I can do at the source to limit the treatment impact when there is a bloom?

- Is there an alternative supply or can I adjust the height of the offtake
- Can the supply flow be increased
- Will mixing/aeration/de-stratification help
- Can a Scum Barrier or floating Silt Curtain assist
- Is it practicable to cover the storage
- Or as a final solution is Chemical Control required
- Pre-oxidation could lead to an increase in extracellular toxins

Powdered Activated Carbon

Agricultural PAC dosing setups can be effective. *Just make it **Black** okay!*

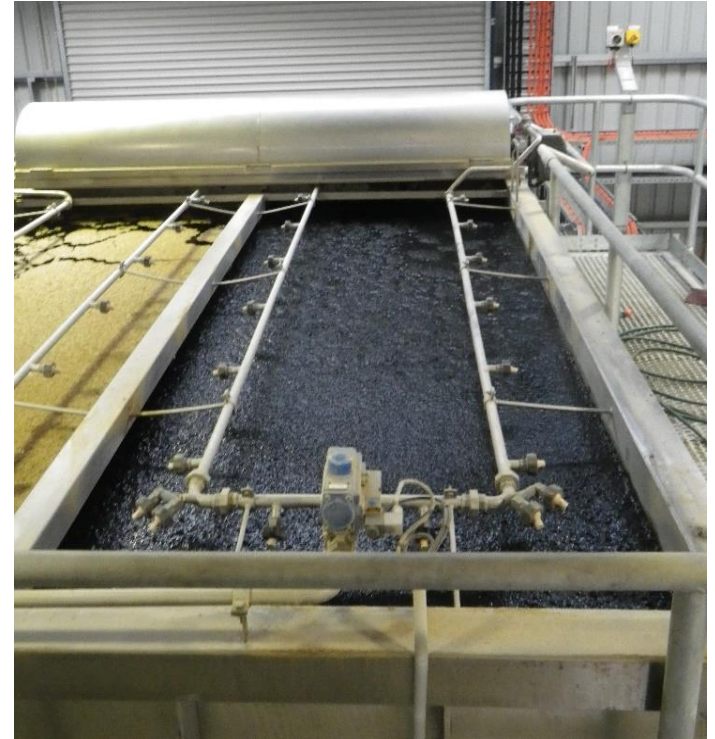
Choose the best quality carbon you can afford, cheap gritty carbon may lead to messy and costly blockages and risk to drinking water

Add the carbon at the earliest possible stage of treatment

Start at 15 – 30 mg/L carbon

PAC will increase the coagulant demand

If treatment is initiated in response to the presence of **toxins** the effectiveness of the process **must** be confirmed by testing for toxin in the product water.



Conventional Treatment



In all likelihood, you will still have to deal with the BGA in the treatment facility. It's best to remove the cells whole but;

- Coagulation of algal cells can be difficult due to their widely variable physical and chemical characteristics
- Complex cell morphology and motility enables cells to escape from flocs
- Extracellular mucilage prevents agglomeration and increases the negative charge at the cell surface, effectively saturating the sites available for inter-particle bridging with organic polymers increasing coagulant demand
- WTP Filtered water turbidity is an inaccurate indicator of cell removal and should be validated

Jar Test!

- How frequently? Depends on risk and BGA can rapidly change, so consider at least twice weekly
- A streaming current device will provide a good indication of what dose rate to start your jar testing at
- Floc formation, settling, and measuring apparent colour and turbidity after filtering through #1 Whatman filter paper will assist in choosing the best jar
- Measuring UV254 and true colour will help to optimise the carbon dose
- Don't be surprised if your dose rate of Alum is >100 mg/L

Sludge Management



The increased load on your systems will need to be managed

- Increase Clarifier wasting or decrease intervals between float removal
- The decay of algae in clarifiers could lead to a release of toxins greater than in the source water

Backwashing may increase, where does the waste water go?

- Can I send the supernatant from wash water tanks to sewer
- Can I alter the operation of sludge / evaporation lagoons
- Is there an alternative to sending supernatant back into the reservoir

Chlorine Disinfection

Chlorine disinfection / oxidation is commonly used as a barrier to BGA toxins but how much and for how long?

Publications vary and the Ct (mg.min/L) changes depending on the type of toxin present and pH of the treated water (chlorine oxidation of anatoxin_a being ineffectual)

Take a conservative approach, aim for 60 mg.min/L

- Lowest storage level
- Short circuiting
- Maximum outflow
- Min outlet free residual

	CWS	CWS	CWS
total volume ML	1	1	1
minimum volume	50%	50% →	75%
calculated volume	0.5	0.5	0.75
TDT mins	166.7	166.7	250.0
T10 mins (*0.3)	50.0	50.0	75.0
outlet free chlorine	0.8 →	1.2	0.8
max outflow l/s	50	50	50
mg.min/L	40	60	60
target 60	check systems	okay	okay

Minor adjustments can make a big difference

I don't think I can treat that!

Then Virtual Pipeline, send in the Tankers

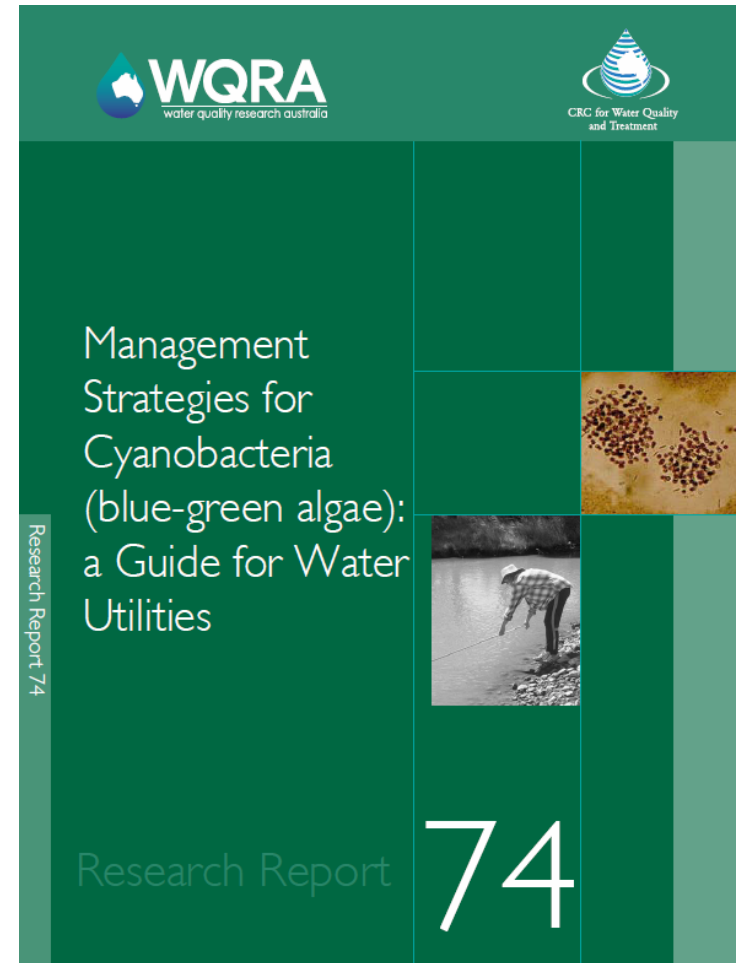
- Confirm Toxicity / DNA & tox screens
- Clean storages (sediments)
- Check fill points, are they secure, are they compatible
- Are tankers available & how many would I need
- Do we need to implement water restrictions
- Look outside your organisation for assistance, call for help!



If treatment is initiated in response to the presence of toxins or toxin-producing cyanobacteria, the effectiveness of the process needs to be confirmed by testing for toxins and cells in the final drinking water.

For further information on these topics and other alternative treatments please read:

Water Quality Research Australia
Management Strategies for
Cyanobacteria (blue-green algae):
a Guide for Water Utilities



Finally my thanks goes out to all the Operators out there working hard during these events.

And for those of you in management please remember there is another risk - **your staff** will be fatigued if they have to spend significant time responding to these issues, **please** look after them.

