



Australian Government  
Department of Agriculture,  
Water and the Environment



Future  
Drought  
Fund



*Vic Hub*  
**DROUGHT &  
INNOVATION**

**VICTORIA DROUGHT  
RESILIENCE ADOPTION  
AND INNOVATION HUB**

Commercial in confidence



**Investigating accumulation phenomenon and management strategies for harmful and nuisance blue-green algae in water supply and sludge/wastewater recovery systems**

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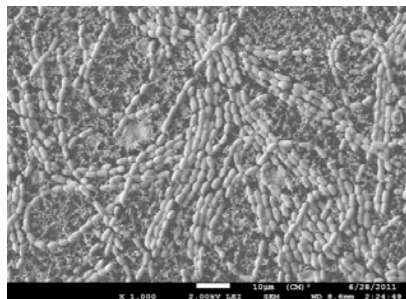
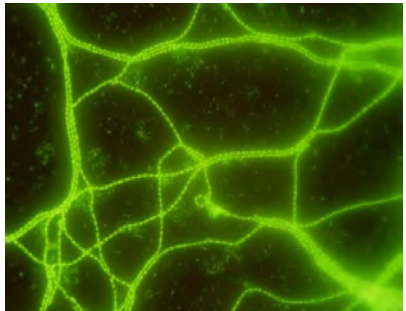
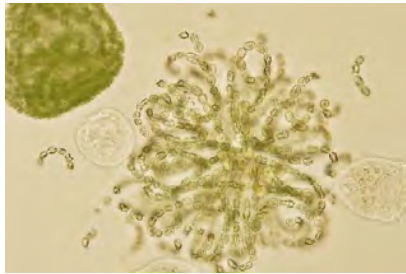
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# Background

- Drought Hub consultations revealed considerable concern about the prevalence of algal blooms during drought
- This innovation project will help develop management strategies to reduce the impacts of algal blooms

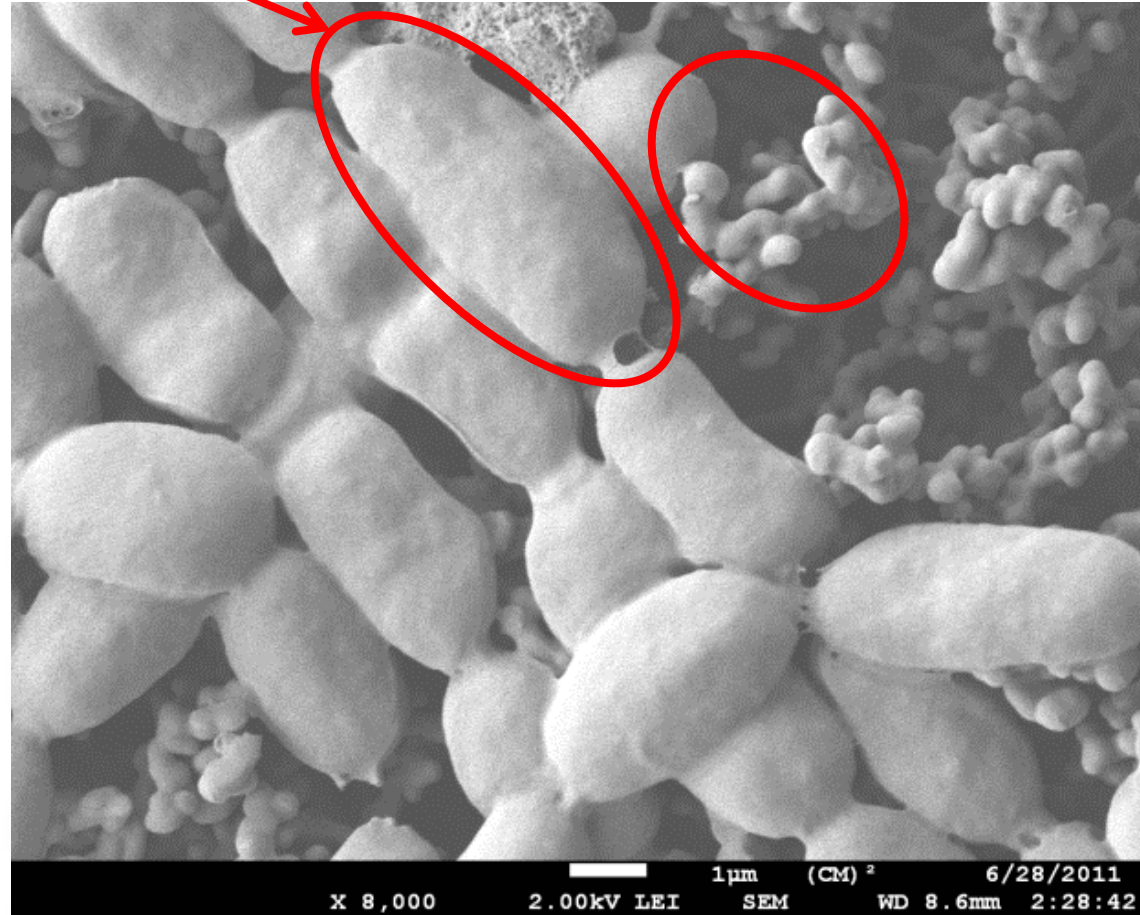
# Toxic cyanobacteria in our water supply systems!!!





# Cell identification/integrity & release

Intra- and extracellular compounds



Cyanobacteria breakthrough into flocculation system



Cyanobacteria breakthrough into mixers



Cyanobacteria accumulation inside DAF sludge



Cyanobacteria breakthrough into clarified water



Factsheet

Recent Australian research on cyanobacteria with implications for risk management within the water industry

10 YEARS Water Research AUSTRALIA

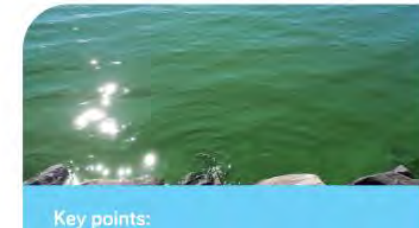
[https://www.waterra.com.au/r9227/media/system/attrib/file/2138/WaterRA\\_FS\\_Cyanobacteria.pdf](https://www.waterra.com.au/r9227/media/system/attrib/file/2138/WaterRA_FS_Cyanobacteria.pdf)

Factsheet

$\beta$ -Methylamino-L-alanine (BMAA): Knowns and unknowns!

Water Research AUSTRALIA

More than 60 years have passed since the world became aware of an unusually high proliferation of neurodegenerative disease within a small tribe in Guam. Known as *lytico-bodig* to the native Chamorro people (combining the terms for paralysis and dementia), this complex of diseases shared similarities with other fatal but little understood motor neuron diseases, like amyotrophic lateral sclerosis (ALS) and Parkinson's disease (PD). The notable increase in patient deaths prompted action from the research community, with specialists from diverse backgrounds – water engineers, biochemists, nutritionists, neuroscientists and neurologists – working to discover the root cause. Today, many years later, the origins of the outbreak remain poorly understood.



Key points:

[https://www.waterra.com.au/r11700/media/system/attrib/file/2807/ColoSSoS\\_FS\\_BMAA\\_2021.pdf](https://www.waterra.com.au/r11700/media/system/attrib/file/2807/ColoSSoS_FS_BMAA_2021.pdf)

# Toxic cyanobacteria in our water supply systems!!!

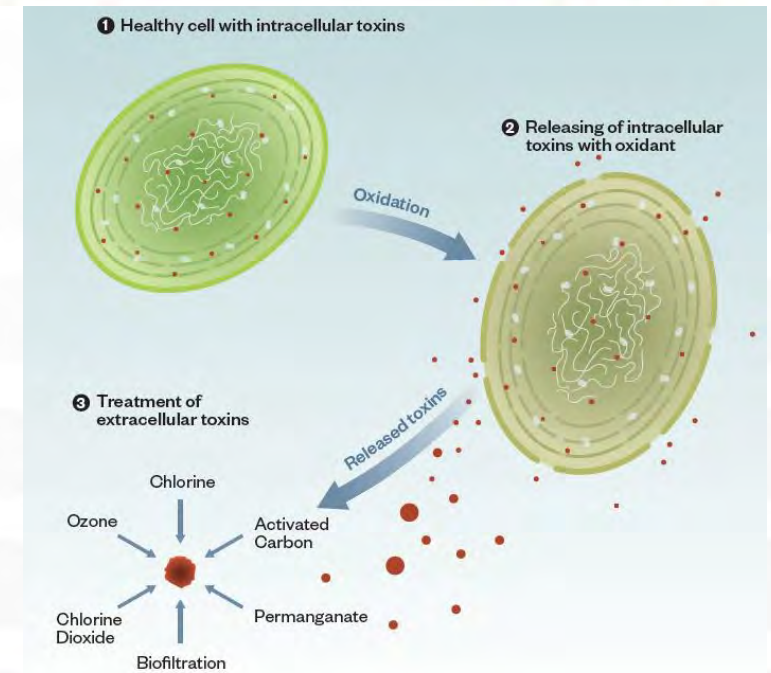
## Filtration



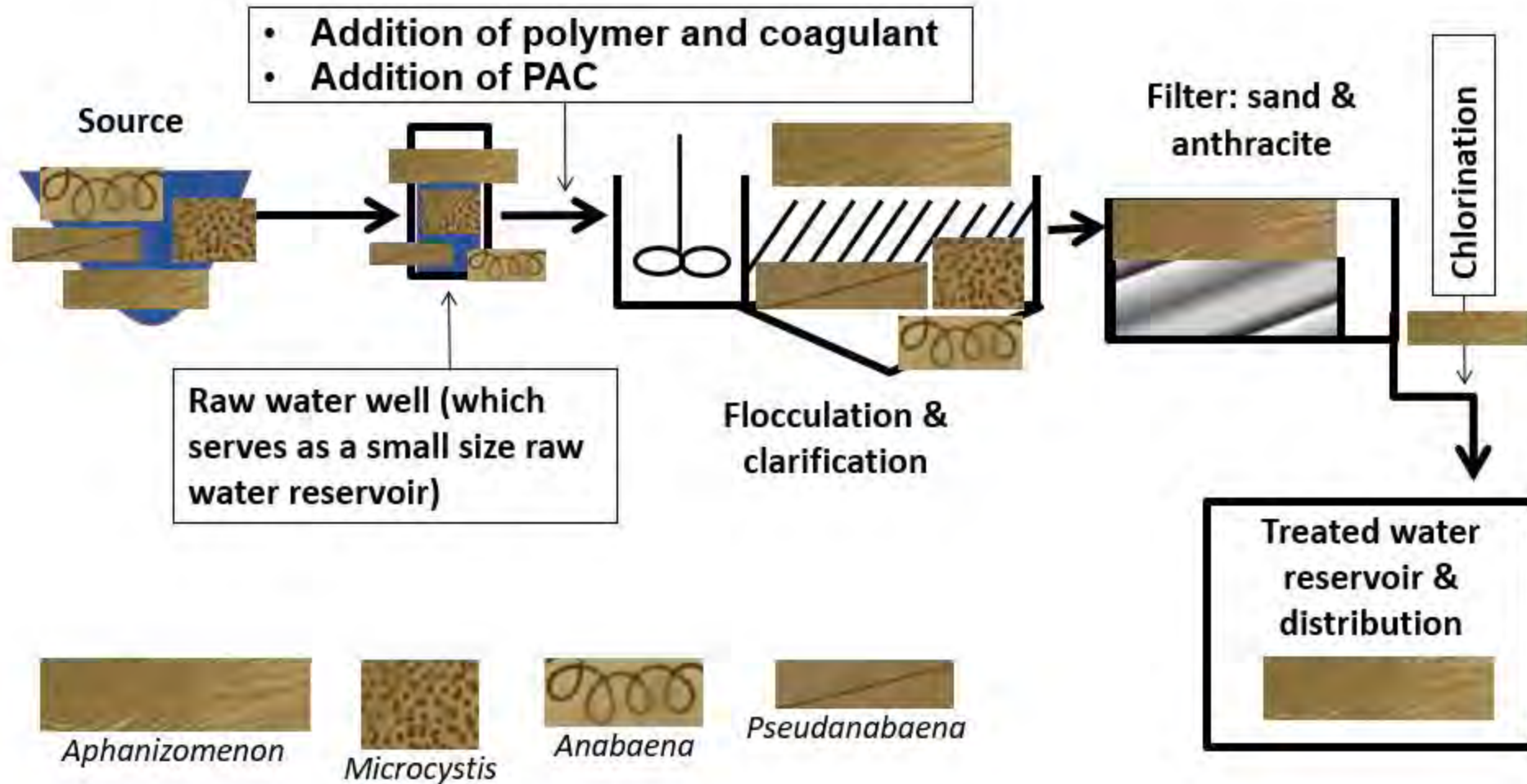
**Table 5. Common Oxidant Efficacy for Treatment of Extracellular Metabolites<sup>13</sup>**



Oxidant	Microcystins	Microcystin-LA	Cylindrospermopsin	Anatoxin A	Saxitoxins	GTX2, GTX3 and C1, C2	Nodularins	MIB and geosmin	BMAA
Free chlorine	pH		pH	Slow/no oxidation			pH		pH
Monochloramine	Slow/no oxidation					?			?
Chlorine dioxide	Slow/no oxidation					?	?		?
Permanganate						?	?	?	Slow
Ozone			pH	pH				(HO <sup>•</sup> only)	pH
Hydroxyl radical					?				pH
UV	High doses	High doses	High doses	High doses	?	?	?	High doses	High doses

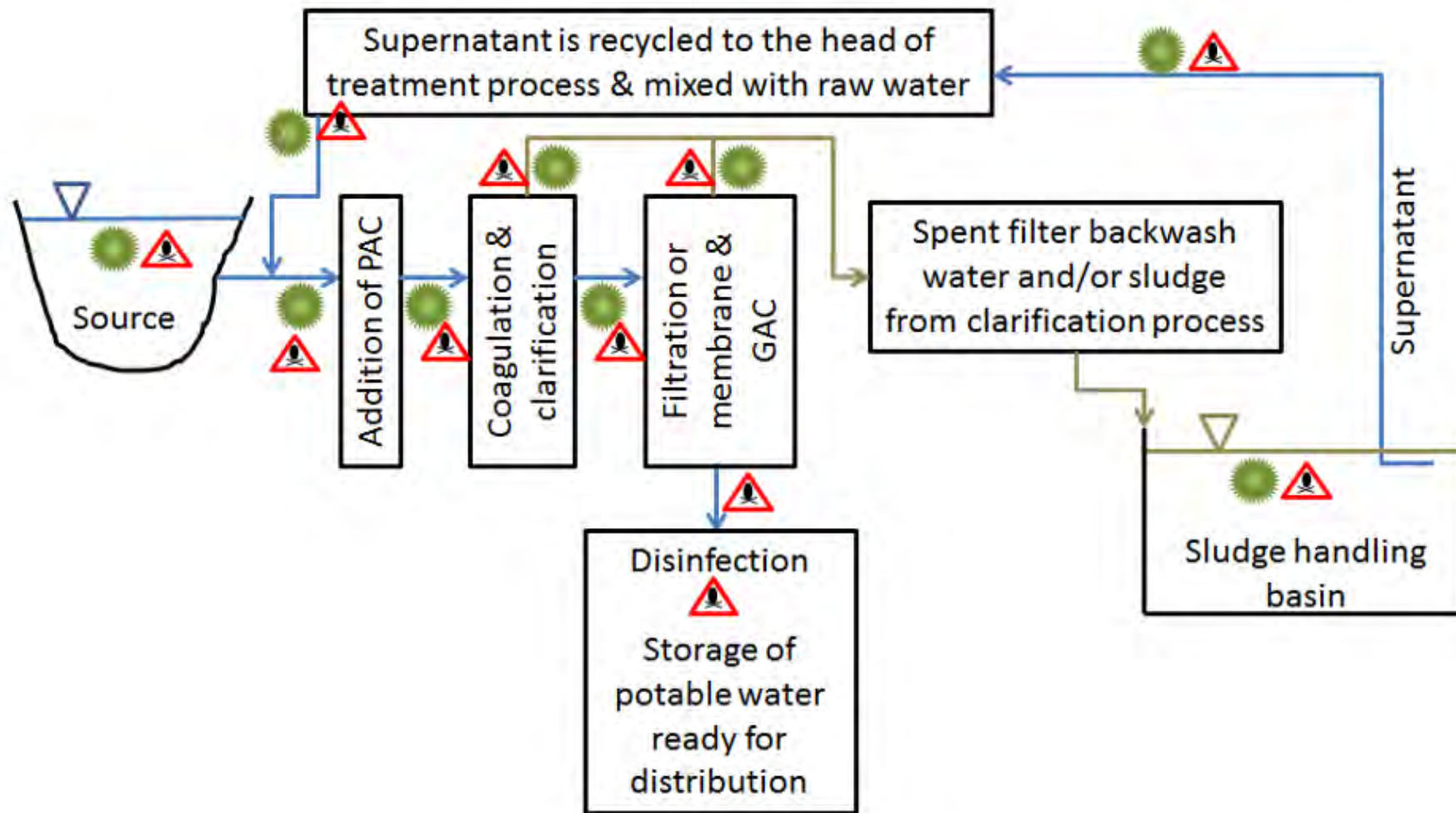
## Dissolved Air Flotation



Breakthrough of cyanobacteria cells within treatment processes:

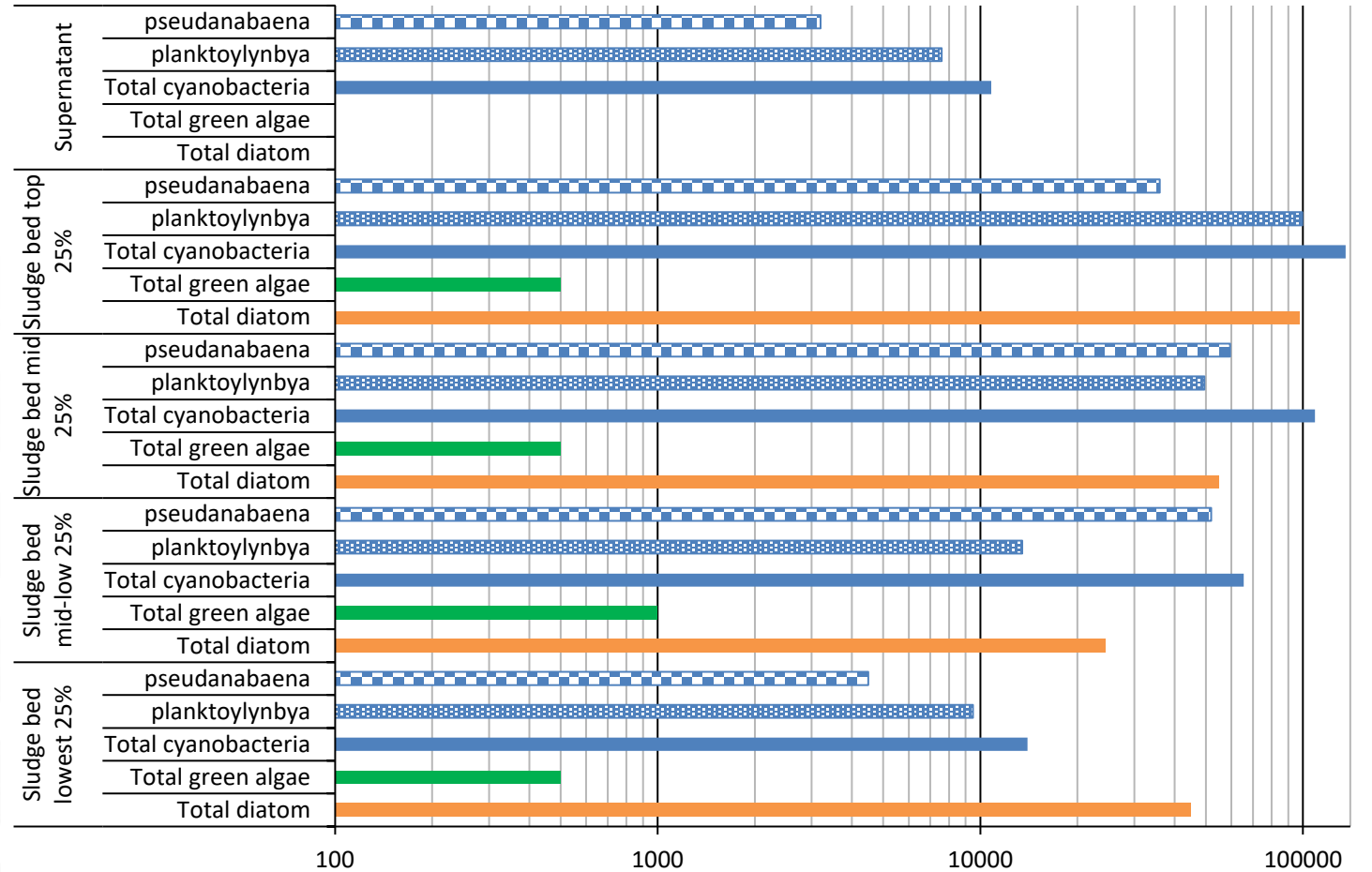
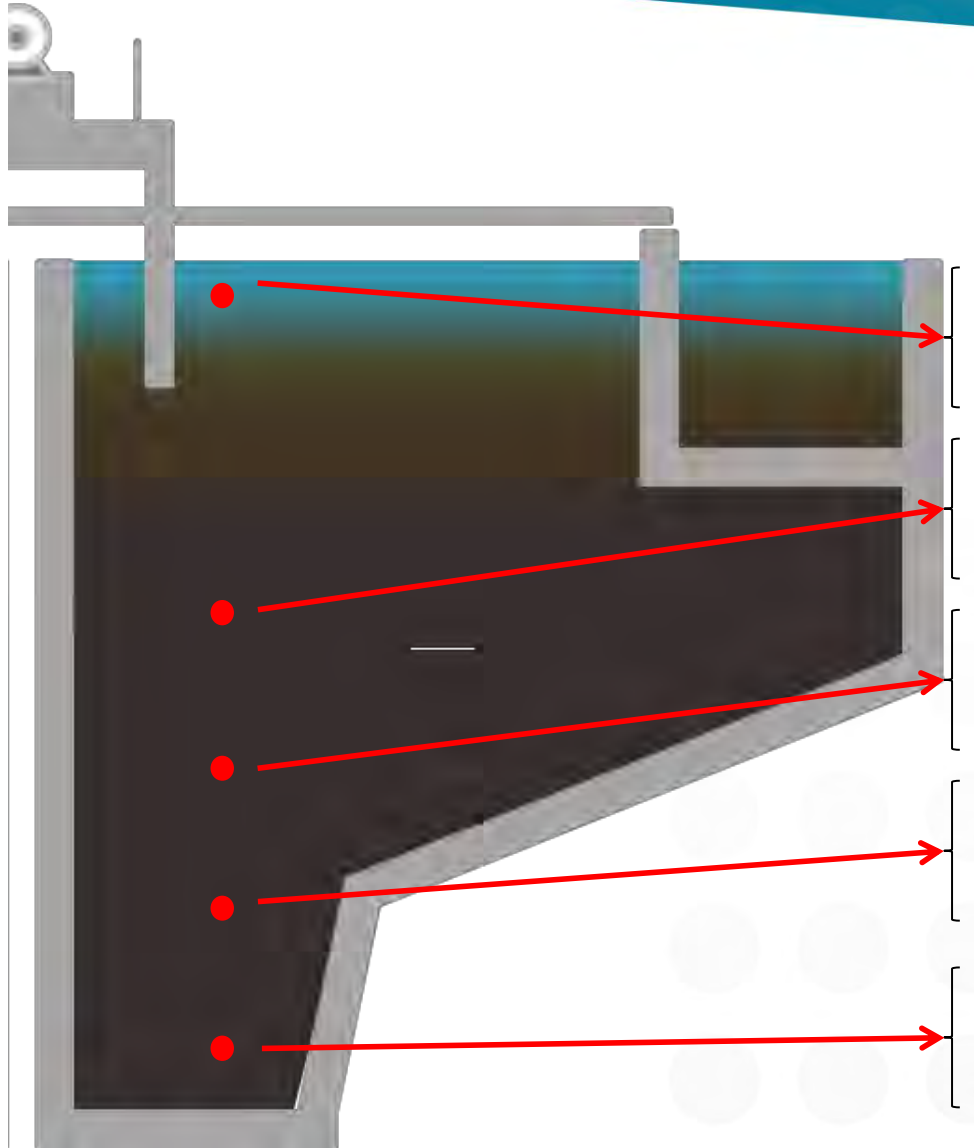


Breakthrough of cells (  ) and T&O or toxins (  ) within treatment processes:



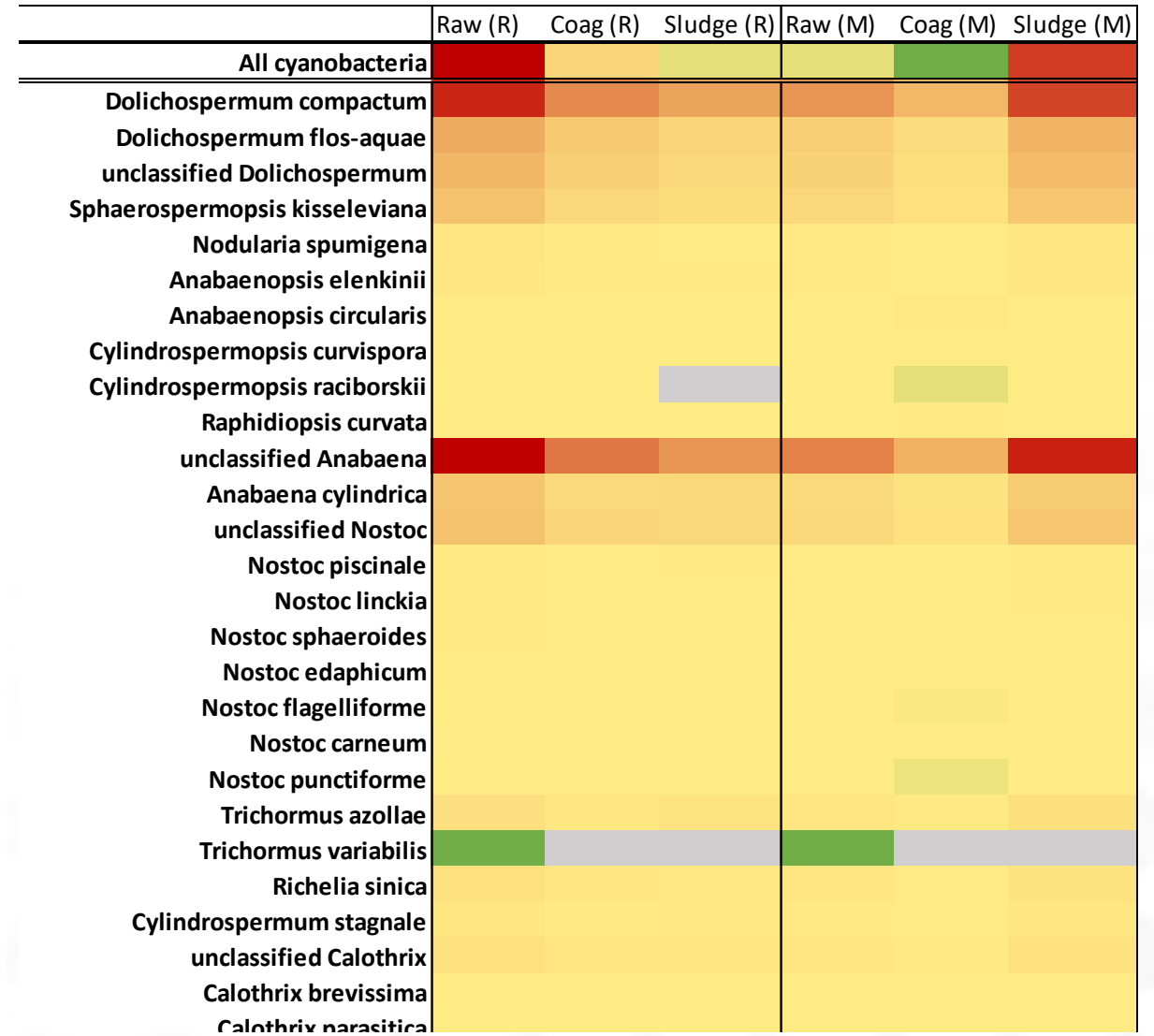
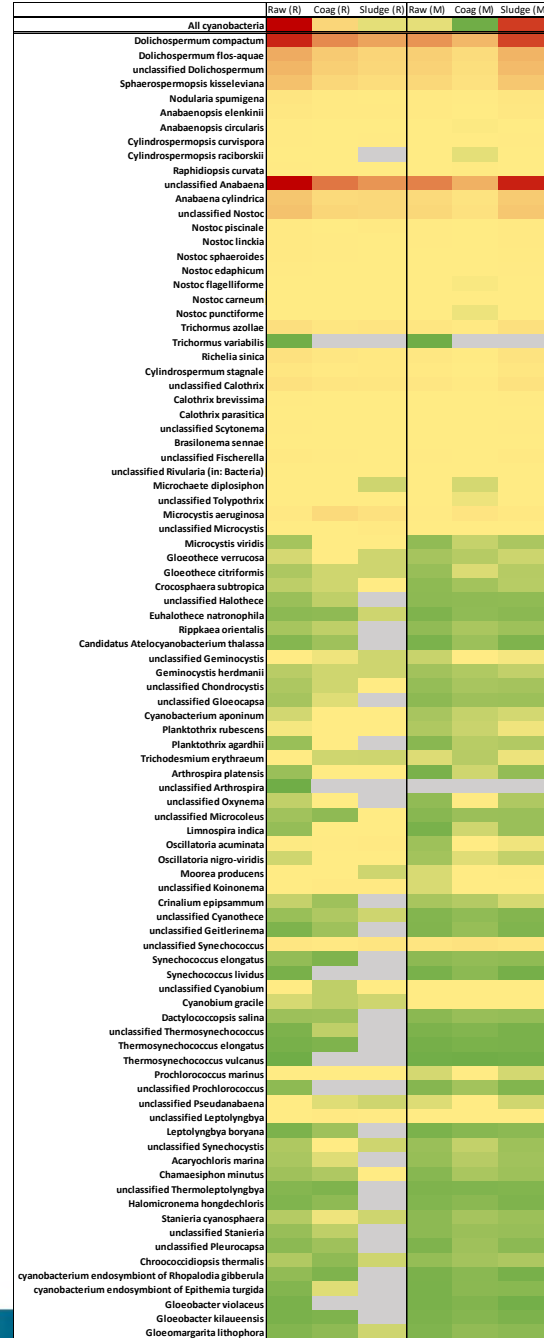


# Fate of cyanobacteria cells within the sludge bed



# Relative abundance of cyanobacteria species fragments within raw, coagulant, and sludge samples

- Green: low relative abundance
- Red: high relative abundance
- Grey: no data



## **Project objectives:**

- (1) Investigate the factors that cause accumulation (herein defined as a net increase over time of cells in supernatant or sludge)
- (2) Discuss feasible interventions to break the cycle of cell accumulation so as to reduce the overall risk that these compounds will occur in the product water at concentrations exceeding their threshold levels or cause issues with treatment processes

# PROJECT OVERVIEW

## Proposed experiments/sampling:

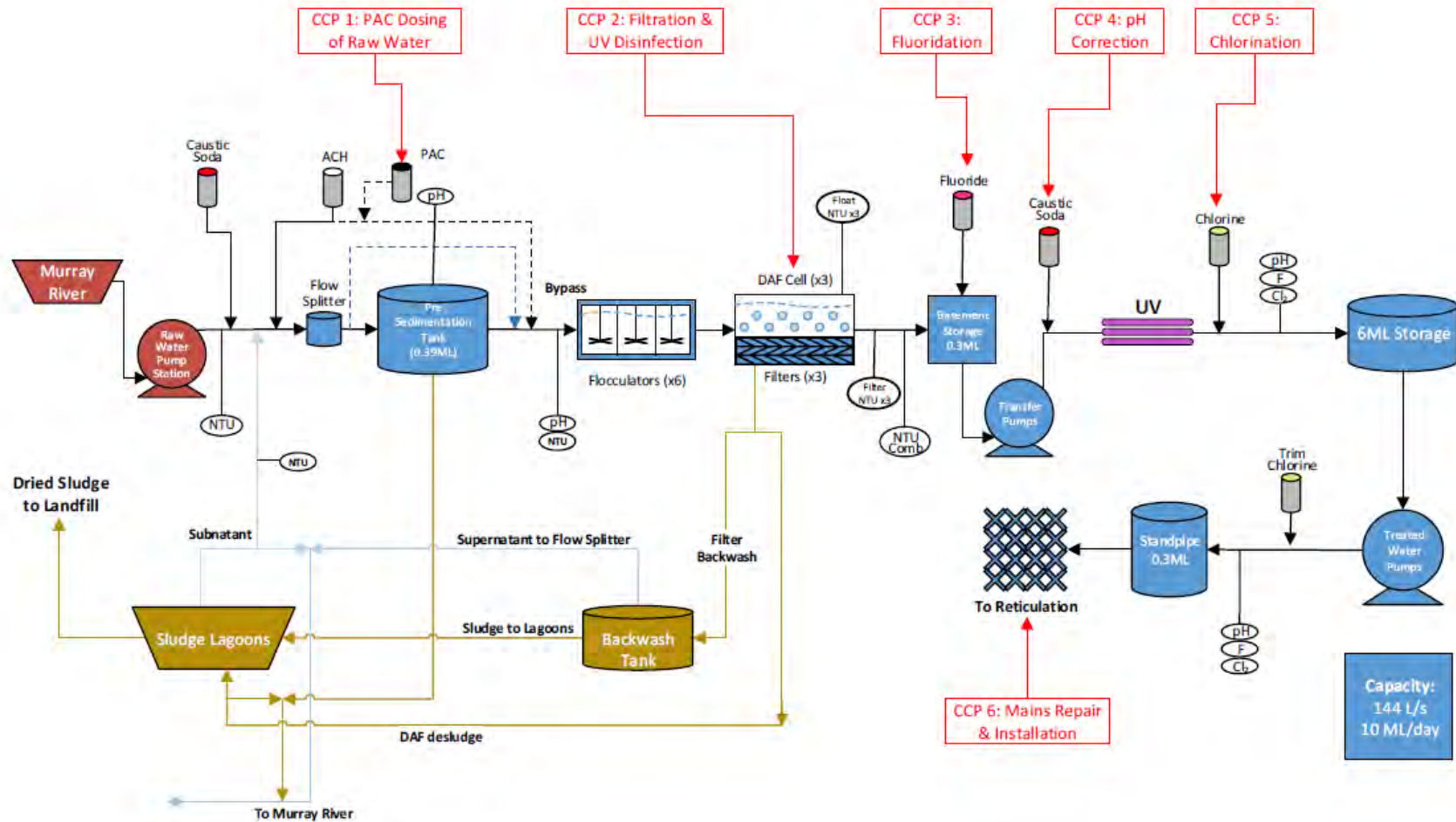
Raw water and product water samples, taken *pre- and post-individual treatment processes*, will be analysed for:

- cyanobacterial/algal speciation
- shotgun metagenomic sequencing
- cell count
- cell integrity metabolite
- and other water quality parameters.

## Outcome and benefits:

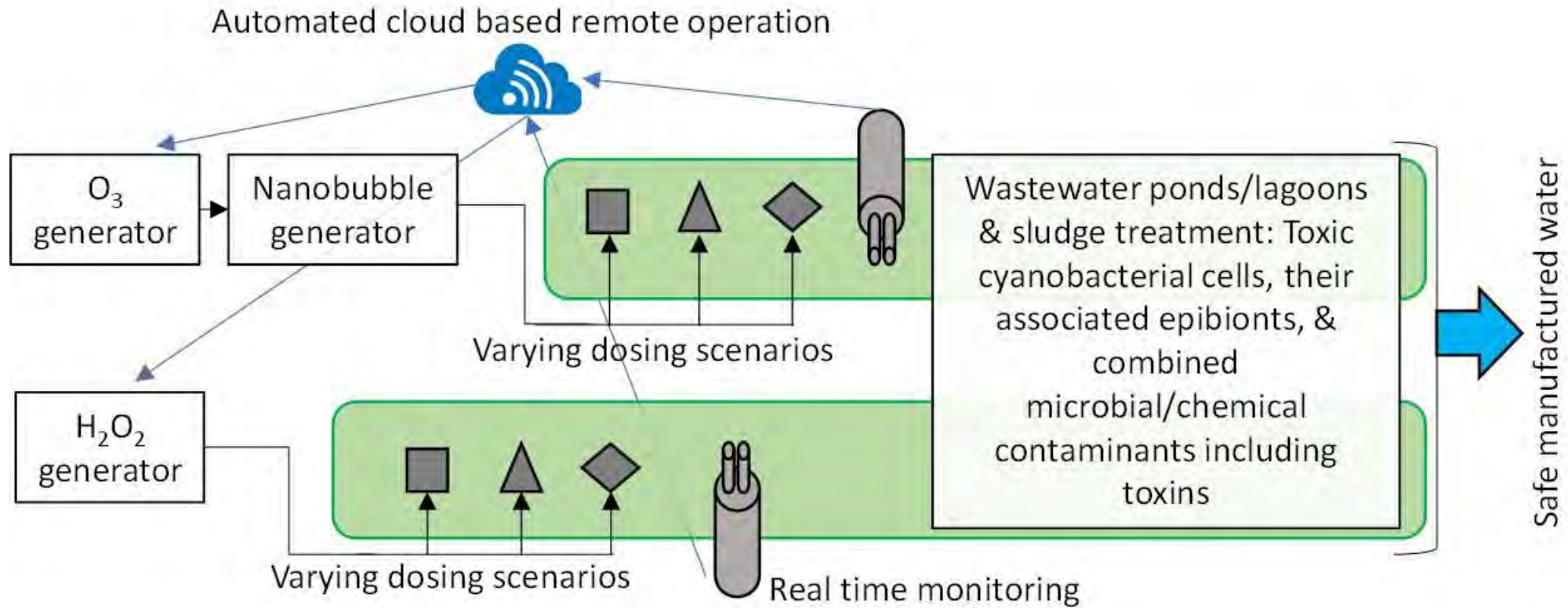
- Identify *critical control points* within the entire process.
- Explore species-dependence of the efficiency of various water and sludge treatment processes.
- Discuss the need for additional early warning systems and management interventions.
- Generate a *response-strategy (e.g. decision-tree)*.

Example Critical Control Points (CCPs) – and water sampling points – for Water Treatment Plant:  
 (no return of supernatant due to manganese)



## Future research direction:

Proposed treatment research work submitted to ARC:



# Project Partners:





**Australian Government**  
**Department of Agriculture,  
Water and the Environment**



*Vic Hub*  
**DROUGHT &  
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**Future  
Drought  
Fund**



**Food & Fibre  
Gippsland**



**BCG**  
SHARED SOLUTIONS



**Mallee Regional  
Innovation Centre**



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