



Government  
of South Australia



SA Water

# Management of treatment sludge impacted by cyanobacteria

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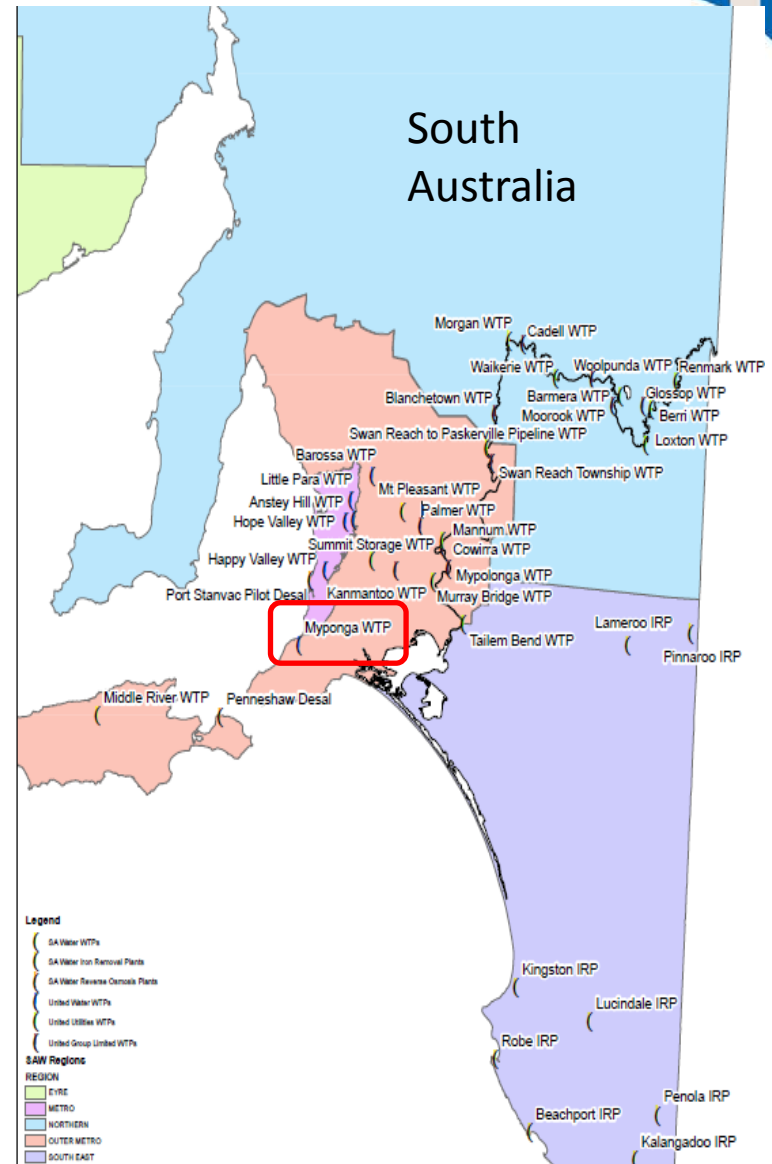
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# Myponga WTP

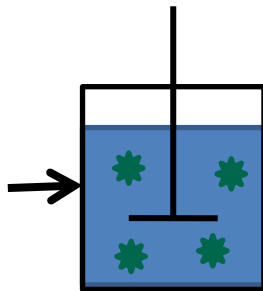
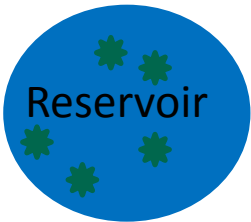
- Located ~50km south of Adelaide
- Myponga River Catchment approx. 123 sq km.
  - Privately owned
  - rural and urban land uses.
- 50 ML/day capacity
- Regular *Anabaena circinalis* blooms





# Water Treatment Process

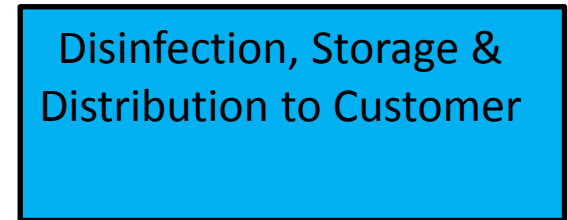
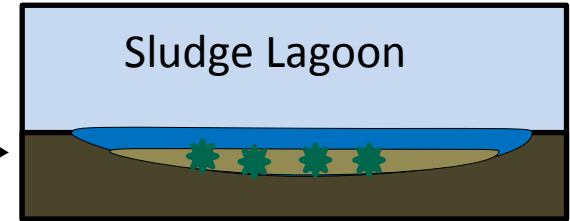
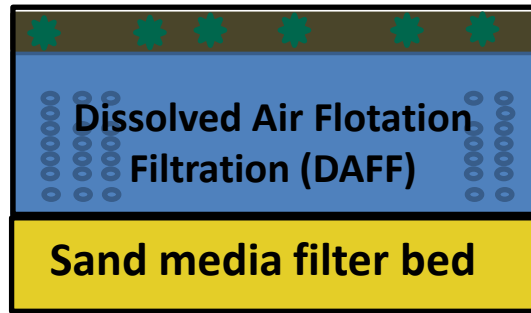
Coagulation &  
Flocculation



Rapid Mix  
Chamber  
-Alum  
-Polymer

## Myponga Design

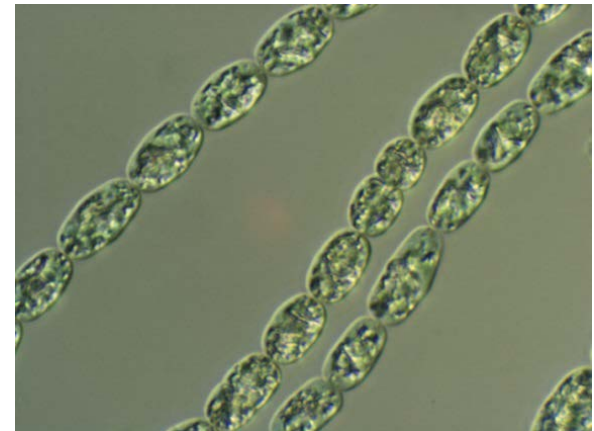
- 6 flotation tanks
- 4 sludge lagoons



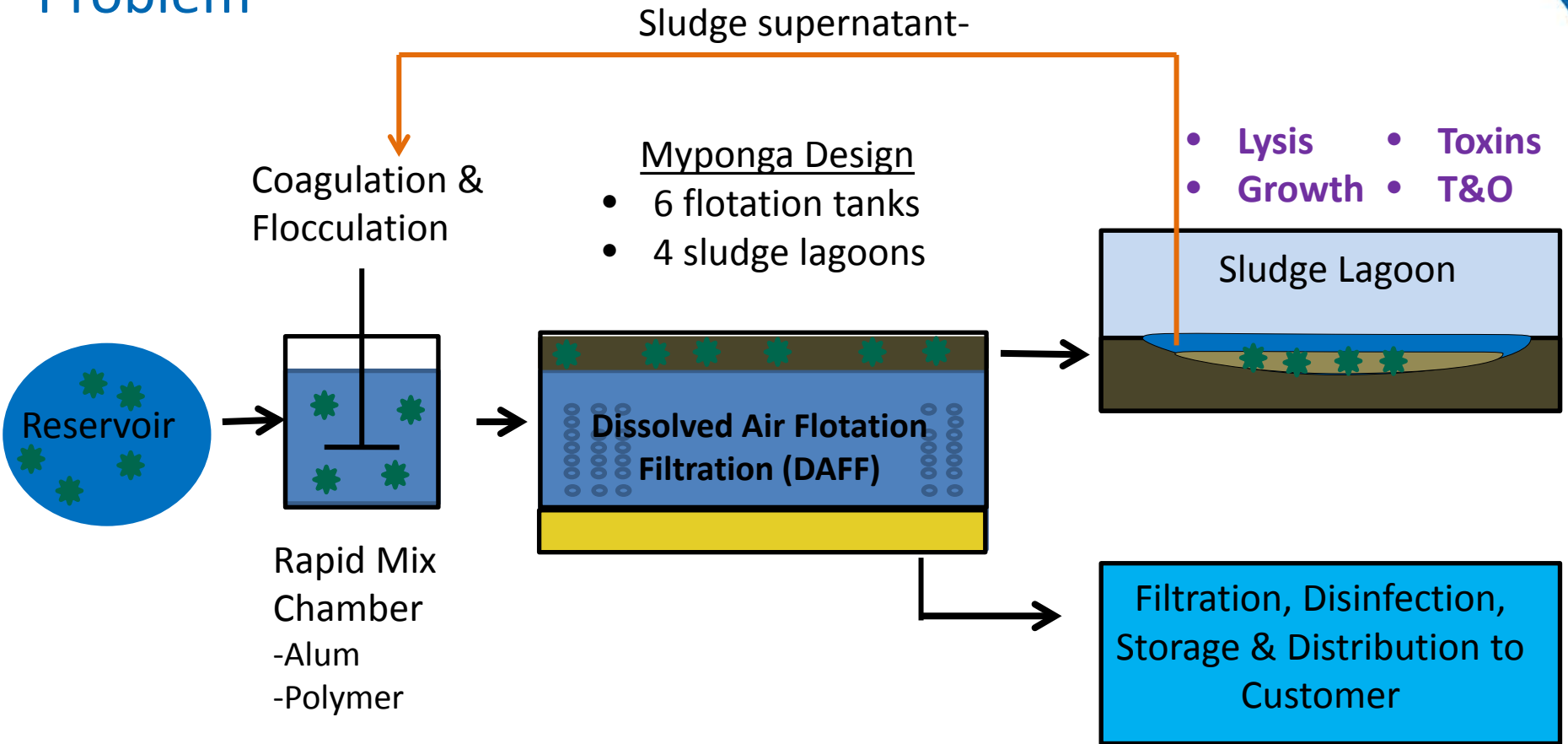
## What's the problem?

Cyanobacteria produce

- ❖ Toxins
- ❖ Taste & Odour (T&O) compounds
  
- ❖ Intracellular: contained within the cells
- ❖ Extracellular: dissolved metabolites
  
- ❖ Extracellular metabolites are not removed through conventional treatment, in this case DAFF process
  
- ❖ Damage during sludge treatment processes
  - ❖ Sludge thickener
  - ❖ Filter press
  - ❖ Centrifugation
  - ❖ Lagoons



# Problem



**Sludge supernatant =  
potential source of concentrated toxins and/or T&O**

## Problem

- Processes occurring in the sludge treatment facility
  - Cell death and lysis in sludge
  - Cell proliferation in sludge
  - Cell proliferation in supernatant
  - Release of intracellular organic carbon (IOC) into supernatant
  - Release of intracellular metabolites into supernatant
  - Adsorption of metabolites onto particles/OC
  - Degradation of metabolites in sludge
- Microorganisms associated with cyanobacteria and/or sludge
  - Degradation of metabolites in supernatant
- Microorganisms associated with cyanobacteria and/or supernatant





## Aims

Assess the risk of recycling the  
sludge supernatant

- To find a surrogate measure  
(non biodegradable) than  
using metabolite release







## Intracellular Organic Matter (IOM)

- Intra-cellular material leak into the extra-cellular matrix.
  - Proteins and polysaccharides
- Leads to an increase of the Dissolved Organic Carbon (DOC)
- Measure DOC



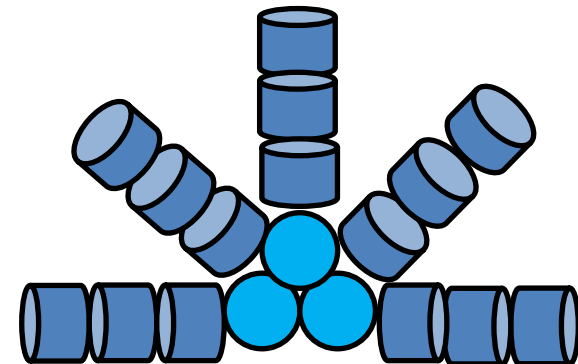
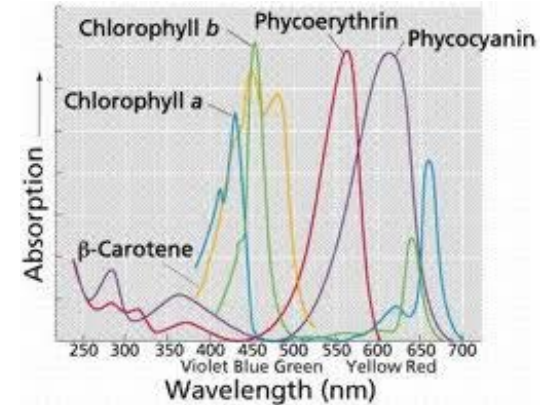
## Verification

### Is the DOC increase coming from cyanobacteria?

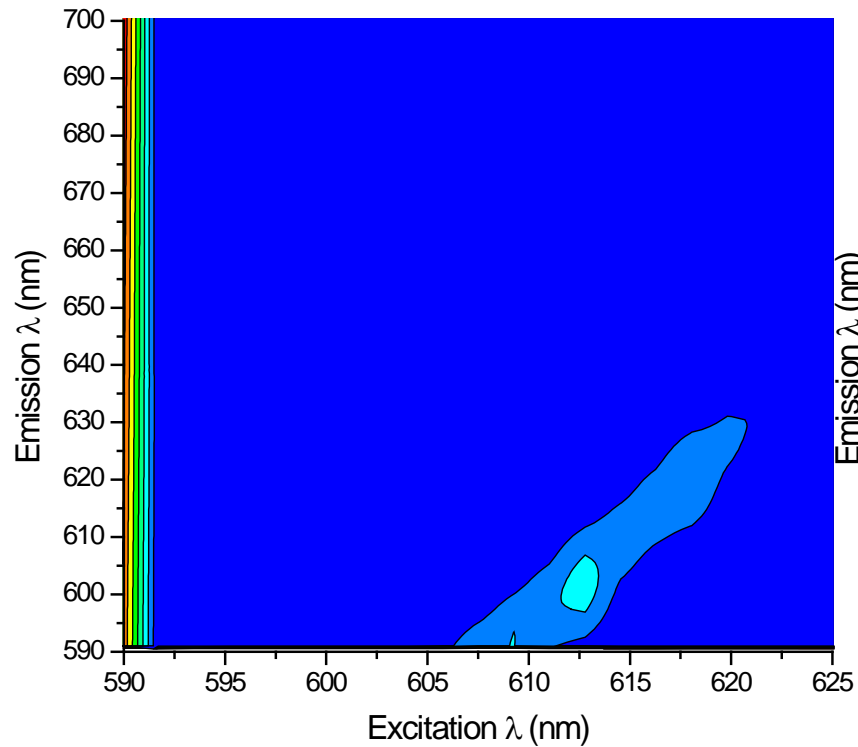
- Phycobillins
  - Unique to cyanobacteria and Rhodophyta
  - Light harvesting molecule

#### Two types:

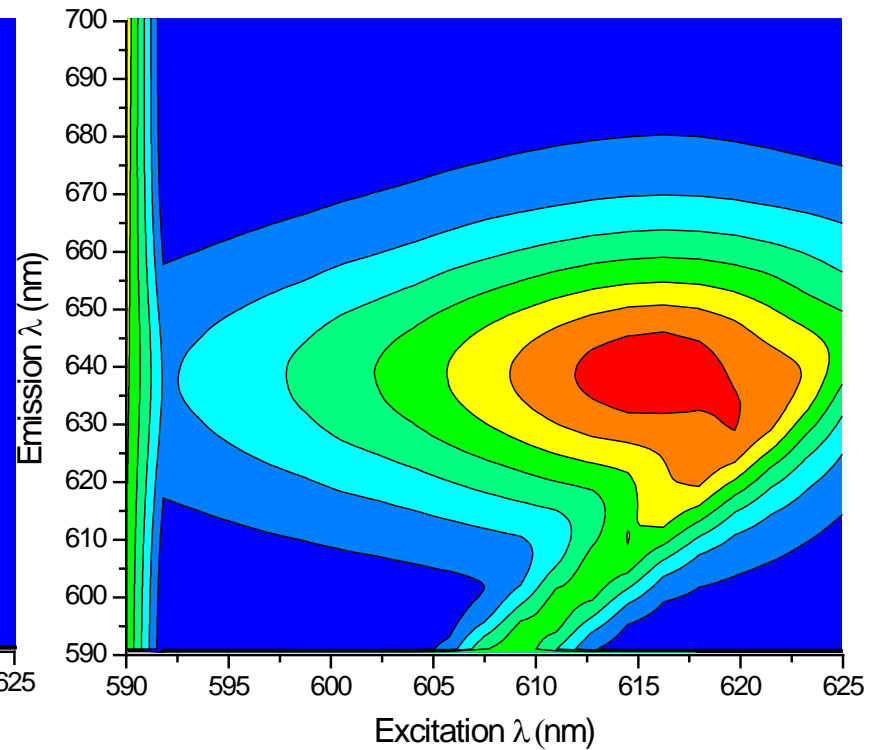
- Phycocyanin in fresh water cyanobacteria (blue-green algae)
- **Phycoerythrin** in marine cyanobacteria
- Enable cyanobacteria to proliferate in low light conditions
- Measure by Excitation Emission matrix (EEM) spectroscopy



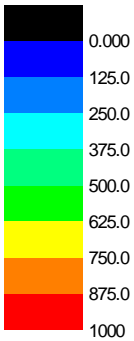
## Presence of phycocyanin



Control



Sample of supernatant



## Verification with cell counts

- Coagulated cells, batch system
- Investigated cell counts in sludge blanket (■) and supernatant as well as DOC release
- Dashed line is the predicted cumulative number of lysed cells
- Sludge cell counts indicate cell proliferation in the sludge therefore viable cells



## Conclusion

- Multiple parameters occurring simultaneously
- Highlighted the risks associated with recycling sludge supernatant during a bloom
  - In presence of a bloom, recycling should stop!
  - If recycling cannot be avoided pre-treatment of the influent raw waters with activated carbon and/or pre-oxidation is recommended.
- IOM can be used as an indirect measure
  - economical
  - no cell counts
  - Less susceptible to removal processes



## Acknowledgments

- WaterRA Project 1033
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- Melbourne Water
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- WSAA

