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Management of toxic cyanobacteria in waste stabilisation ponds

Removal of cyanobacteria and microcystins from waste stabilisation ponds
by hydrogen peroxide addition

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Significance

- Treatment options assist us in developing management plans
- Cyanobacteria in WSPs often overlooked as they are low priority compared to drinking water and recreational reservoirs



Merredin WWTP (Barrington 2009)



Cyanobacteria and cyanotoxins

- Harmful to humans and the environment
 - Shading of underlying organisms
 - Oxygen depletion
 - Acute and chronic effects of toxins
 - Bioaccumulation of toxins



Microcystis aeruginosa (Ghadouani 2006)



Cyanobacteria in WSPs

- WWTPs discharge to environment or reuse
- Inhibit treatment
 - Shading
 - Toxins
 - Increased BOD
 - Sludge and suspended solids
- Inadequate treatment of effluent



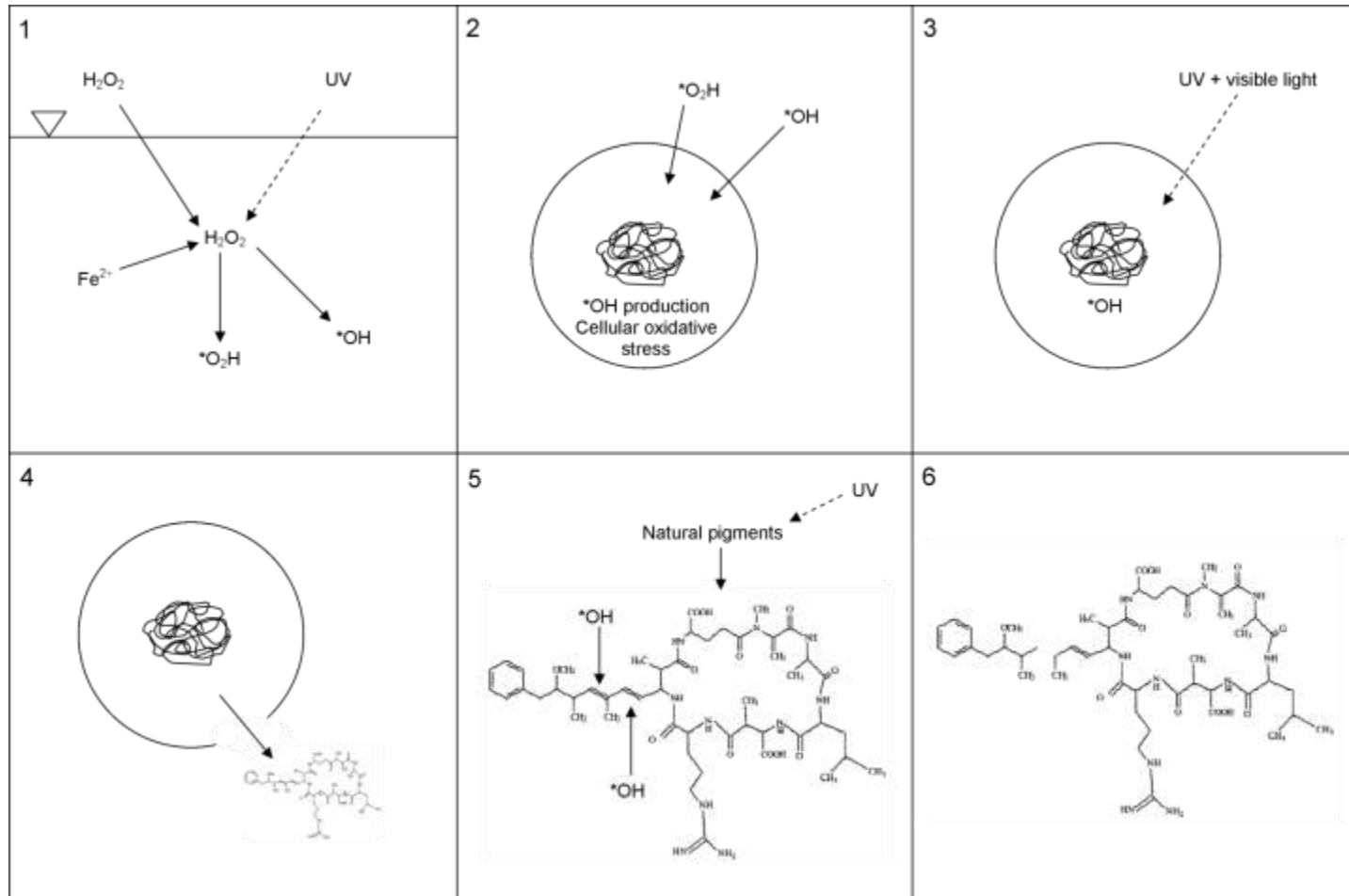
Merredin WWTP (Barrington 2009)



Current cyanobacterial treatment

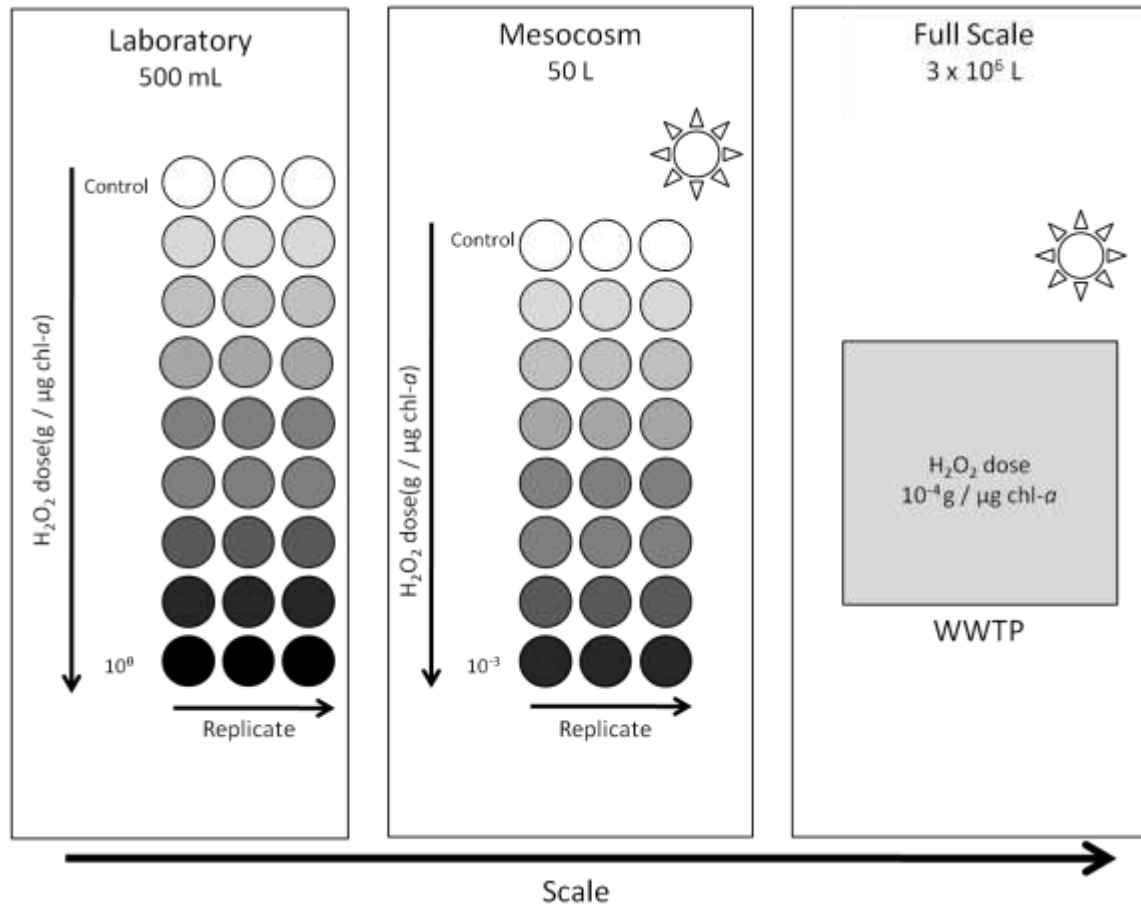
- Dangerous by-products (eg. trihalomethanes)
- Accumulation of metals (eg. aluminium, copper)
- Current management focused towards drinking water and recreational reservoirs
- Based on mitigating risk to human health, not the environment

The potential of hydrogen peroxide





Experimental design- Cyanobacteria

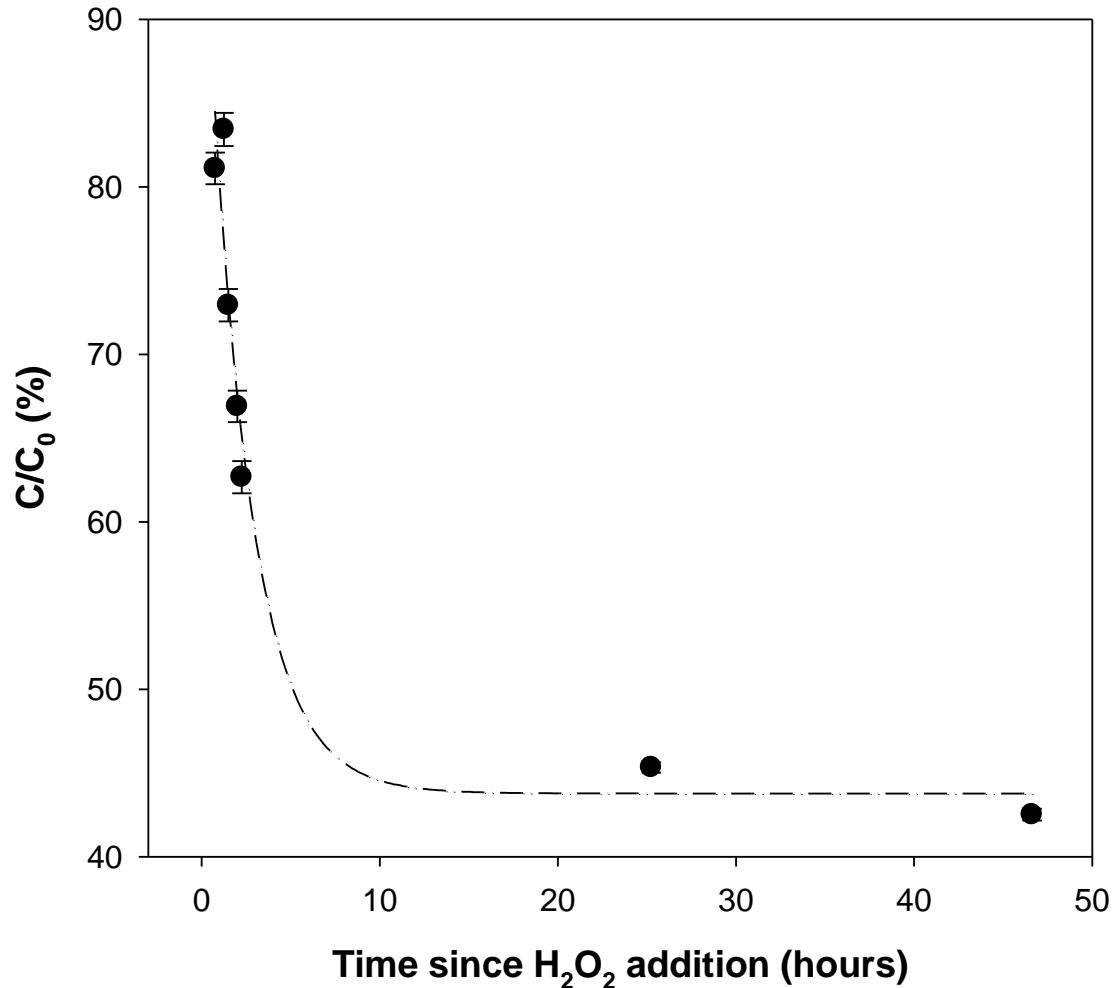


Barrington, D. J. & Ghadouani, A. 2008, 'Application of hydrogen peroxide for the removal of toxic cyanobacteria and other phytoplankton from wastewater', *Environmental Science & Technology*, vol. 42, no. 23, pp. 8916-8921.

Barrington, D. J., Ghadouani, A. & Ivey, G. N. 2011, 'Environmental factors and the application of hydrogen peroxide for the removal of toxic cyanobacteria from waste stabilization ponds', *Journal of Environmental Engineering*



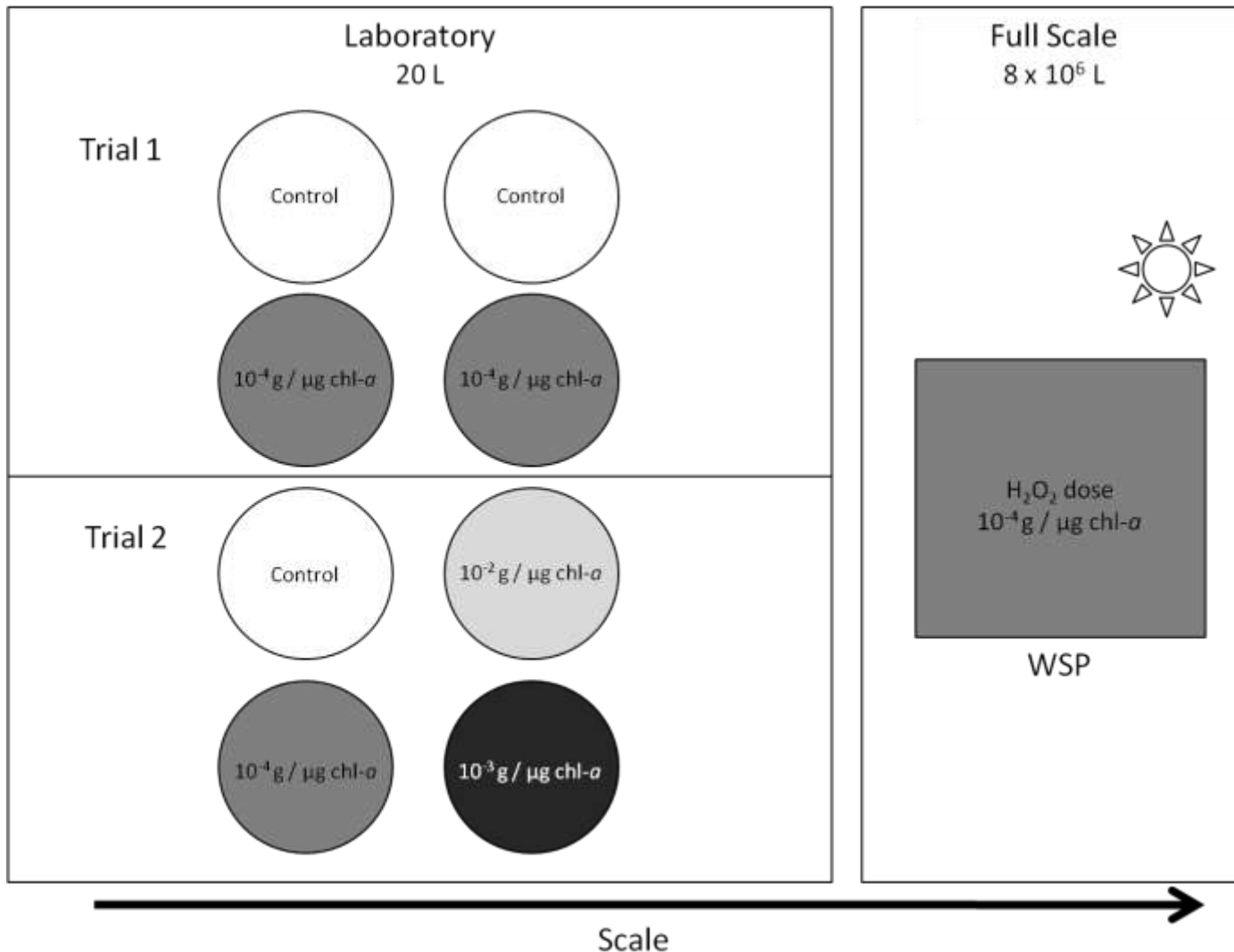
Full-scale field trial



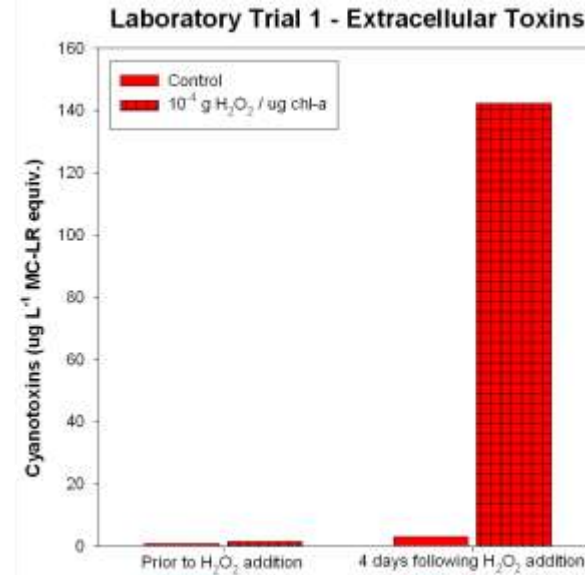
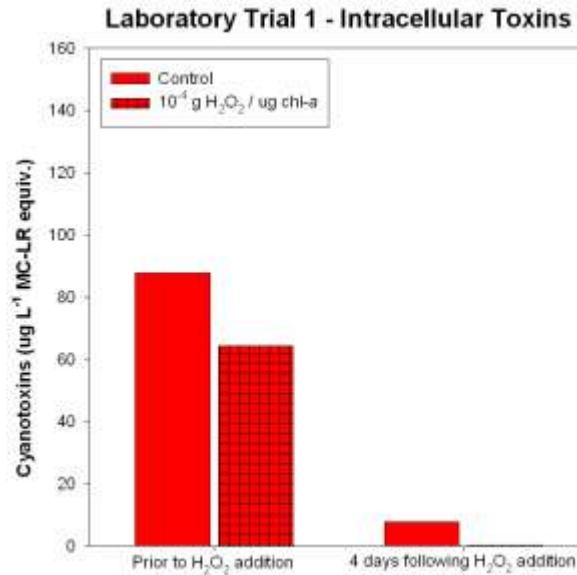
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Experimental design- cyanotoxins



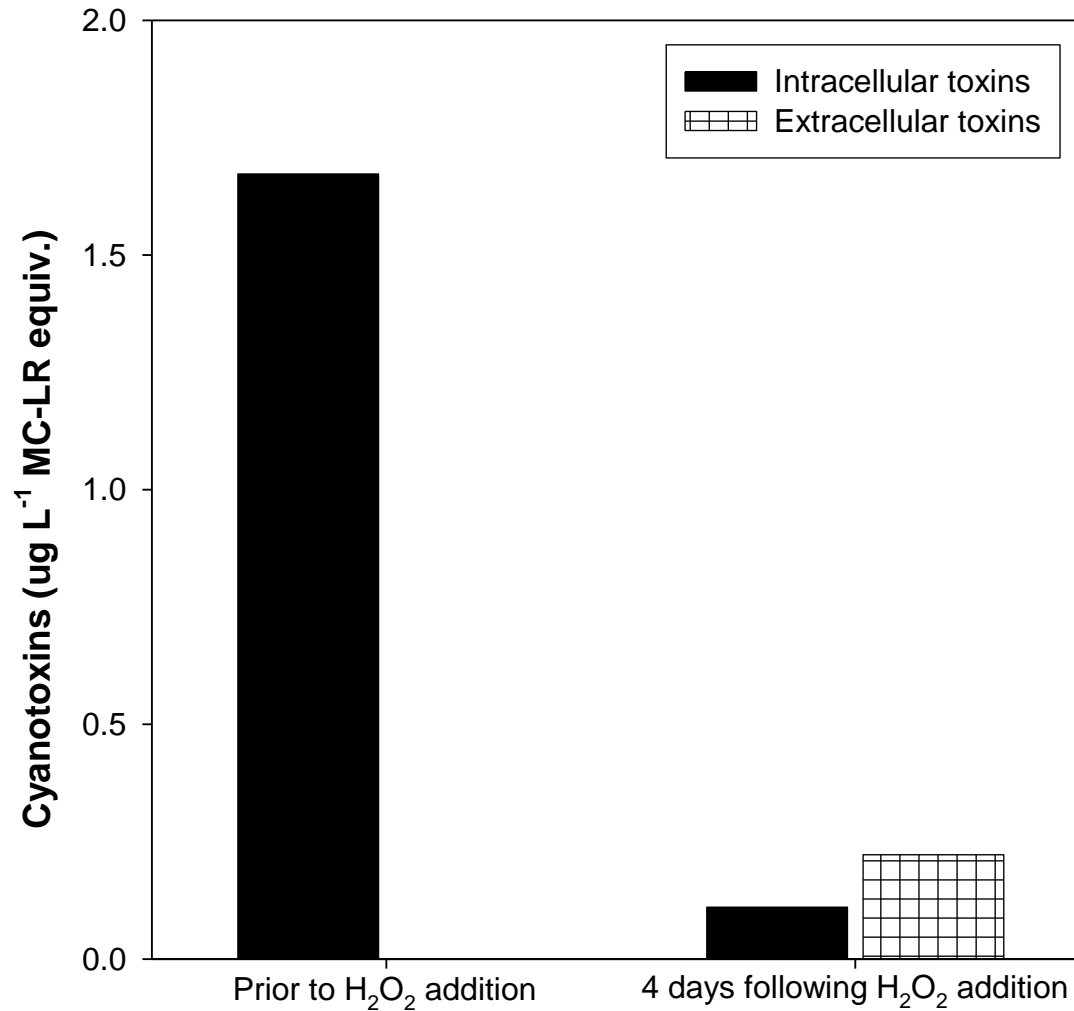
Cyanotoxins

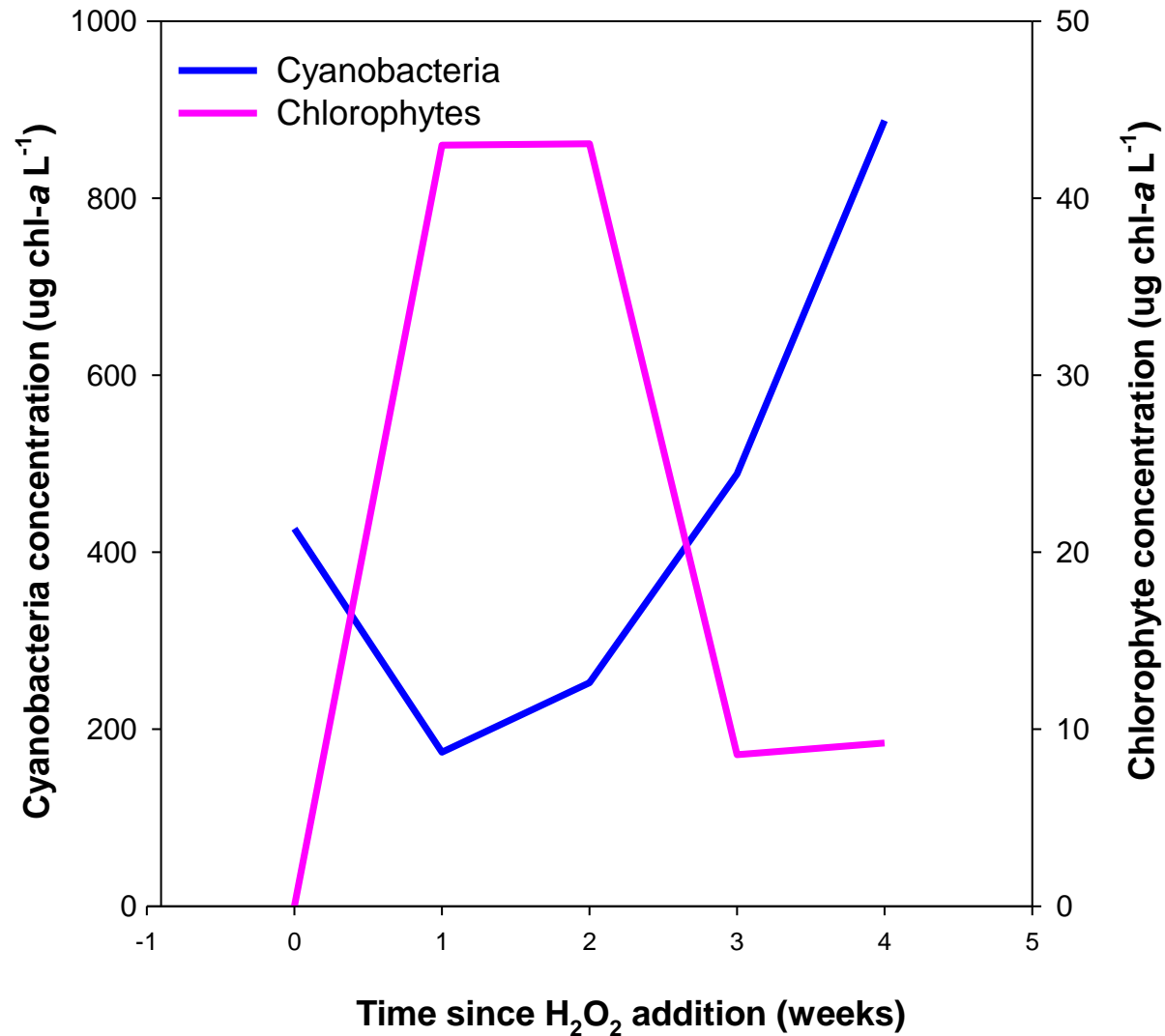


	Initial Total Coliforms (cells / 100 mL)	Final Total Coliforms (cells / 100 mL)
Control	>240000	>240000
Dosed Mesocosm	>240000	<10



Merredin Field Trial





Barrington, D. J., Ghadouani, A. & Ivey, G. N. *In prep*, 'Hydrogen peroxide reduces cyanobacteria and cyanotoxins in waste stabilisation ponds'

Prior to cyanobacterial season

Prevention
Where feasible, prevent blooms through nutrient reduction, destratification, and emerging prevention technologies

Contingency planning
Consider contingencies for the possibility that effluent is not of satisfactory quality for release following bloom treatment (Table 1).

Routine monitoring and bloom identification
Determine the likelihood of cyanobacterial bloom formation through routine monitoring (Table 2).

Cyanobacterial bloom suspected

Situation assessment
Determine the risk posed by a cyanobacterial bloom in the given WSP. Determine whether action should be taken (Tables 3-5 and Figure 2).

Treatment of cyanobacterial bloom required

Bloom mitigation
Determine concentration of H₂O₂ (Equations 1 and 2) and optimum treatment procedure (Table 6).

Natural degradation
Allow for natural degradation of cyanobacterial toxins throughout the WWTP. Monitor at pond outlets to determine the rate of toxin decay. Return to routine monitoring or invoke contingencies if necessary

Contingency Invocation
Invoke planned contingencies. Re-evaluate the treatment and contingency plans for following year





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