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# Warragamba Dam Blue-green Algae Action Plan

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# Presentation Outline / Scope

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1. Why was the Warragamba Dam Blue-green algae Action Plan (WDBGAAP) developed?
2. What is the focus of the Action Plan?
3. What research is being undertaken as part of the Action Plan?



# Why was the Warragamba Dam Blue-green Algae Action Plan developed?

- Developed following the algae event that occurred in the Warragamba Dam storage in 2007.
- Provided a framework for the Sydney Catchment Authority (SCA) and Sydney Water to undertake a range of actions to manage blue-green algae from the catchments through to customers' taps.
- Jointly agreed to by the SCA, Sydney Water and NSW Health.
- Established clear actions and timeframes for implementation.
- The Action Plan clearly identified the responsible agency.



# What is the focus of the Action Plan?

- Minimise the occurrences of excessive algae events in the SCA's storages.
- Enhance techniques for predicting algae outbreaks.
- Implement enhanced operational response procedures.
- Implement appropriate treatment processes to mitigate any health or taste and odour risks due to the algae.
- Increase the knowledge of algae production, reservoir behaviour, treatment options and preventative measures.



# What is the focus of the Action Plan?

- A mix of short and longer term actions.
- The Action Plan has been subject to regular review to determine the status and effectiveness of the strategies and to prioritise subsequent programs.
- To effectively track progress:
  - actions incorporated into agency business processes
  - monthly progress reports are submitted to the Boards of Sydney Water and the SCA
  - status update reports submitted to Government.



# Components of the Action Plan

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- **Part A: Operational response (short term response)**
  - Increased water quality monitoring
  - Outlet configuration at Warragamba Dam
  - Warragamba distribution system contingency plan
  - Alternate supply sources
  - Revise Prospect Reservoir pumping protocols.
- **Part B: Catchment management (long term response)**
  - Healthy Catchments Program review
  - Improved sewerage management related programs
  - Onsite sewage management program
  - Statutory planning
  - Catchment Decision Support System.



# Components of the Action Plan

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- **Part C: Reservoir management (medium term)**
  - Investigate algal control options
  - Trialling of physical and chemical algal control solutions
  - Reviewing Shoalhaven system operations
  - Hydrodynamic influence of water supply outlets in SCA reservoirs.
- **Part D: Treatment strategies (short term) (Sydney Water)**
  - Ability of Chlorine to destroy algal toxins
  - Powdered Activated Carbon (PAC) bench tests
  - PAC dosing at Warragamba and Orchard Hills
  - Investigate Ultraviolet/Hydrogen Peroxide and PAC treatment for Prospect.



# Components of the Action Plan

- **Part E: Research (medium to long term)**
- **Part F: Monitoring (short to long term)**
  - Investigative monitoring of 2007 bloom
  - Trial real time algal monitoring techniques
  - Review SCA Water Quality Incident Response Plan, water monitoring programs and sampling and analytical methods
  - Develop remote sensing/mapping capability
  - Incorporate a water quality modelling module in SCA's Reservoir Management System (SCARMS).



# Components of the Action Plan

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- **Part G: Communication and consultation**
  - Warragamba Algal summit
  - Warragamba Dam risk assessment
  - Develop communication and consultation strategy
  - Implement communication and consultation strategy.



# Research being undertaken as part of the Action Plan

- **Preliminary investigation of the cause of the 2007 Warragamba Dam algae bloom**
  - examination of the conditions (e.g. water quality, inflows, storage hydrodynamics, biology) within the lake and its tributaries
  - impact of Shoalhaven transfers
  - taste and odour investigations.



# Research undertaken as part of the Action Plan

- **Potential seeding of algae from the sediments**  
Review of the potential for dormant phases of species to become 'seeds' to trigger an algal bloom.
- **Biological control of algal blooms**  
Review to characterise the potential value of biological control of algal blooms in Warragamba Dam.
- **Changes in algal species over time**  
Analysis of historical data from SCA reservoirs to investigate the dynamics in dominant blue-green algae species.



# Research undertaken as part of the Action Plan

- **Further investigations into the causes of algal blooms in reservoirs**
  - Underflow/interflow events, thermal fluxing/wind forcing, water circulation and risk assessment of storage volume inflow, volume and seasonal thermal cycle relationships
  - Nutrient mass balance and the role of anoxic sediment nutrient release
  - The extent of internal nutrient loading from sediment and the origins of those nutrients
  - How inflows travel through the storage and how this affects nutrient processes



# Research undertaken as part of the Action Plan

- **Trialling of algal control solutions**
  - Solarbee® technology.



- Trialling of a modified clay product (Phoslock)



# Research undertaken as part of the Action Plan

- **Potential for algal populations to become toxic**
  - Determination of the mechanisms for change in the dominant strains and species within a bloom from non-toxicogenic to toxicogenic blue-green algal strains.
  - Determination of the factors responsible for the turning on/off of blue-green algal genes to produce toxins.
  - Determination of the mechanisms by which toxin transport from the blue-green algal cells to the water occurs.



# Research being undertaken as part of the Action Plan

- **Determining the fate of toxins, and taste and odour compounds in reservoirs**
  - Determine the mechanisms responsible for the degradation of toxins, and taste & odour compounds, with specific reference to the Warragamba Dam context.
  - Determine the loss rates for toxins, and taste & odour compounds, with specific reference to the Warragamba Dam context.



# Research undertaken as part of the Action Plan

- **Influence of environmental conditions on blue-green algal bloom development**
  - Investigate sediment efflux and transformation rates in Warragamba Dam and the relative contributions of nutrients within the lake and from external sources.
  - Investigate and develop improved options for monitoring 1) water chemistry and, 2) algae
  - Investigate physico-chemical factors and speciation/ bioavailability of nutrients (minerals and bulk nutrients)  
Prof. David Waite (UNSW) 3 year ARC-Linkage project



# Summary

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- **Action Plan implementation is well advanced.**
- **SCA better understands the processes leading to a heightened risk of blue green algal blooms developing.**
- **Enhanced management of the storages in relation to blue-green algae.**
- **The remaining research will provide greater understanding and improve management.**

