



Department of  
Primary Industries  
Office of Water

# Cyanobacterial blooms and response management in NSW

Presentation to AWA Northern Regional Conference

# What are Cyanobacteria

- Also known as Blue-green algae
- Are actually photosynthetic bacteria
- Live in a wide range of habitats, but those of most concern to humans are those that live in freshwaters, especially within the water column
- Prone to form excessive growths (blooms) that can impact on water quality



# Causes of blooms

- Excessive nutrients, especially phosphorus, also nitrogen
- Warm water conditions (many cyanobacterial species with optimal growth rates at around 25°C)
- Stable, non-mixing, non-turbulent water conditions
- Alkaline pH (> 8.00).
- Sufficient light availability
- Generally when optimal conditions occur together
- Exceptions – E.g. sometimes winter blooms (cold water)

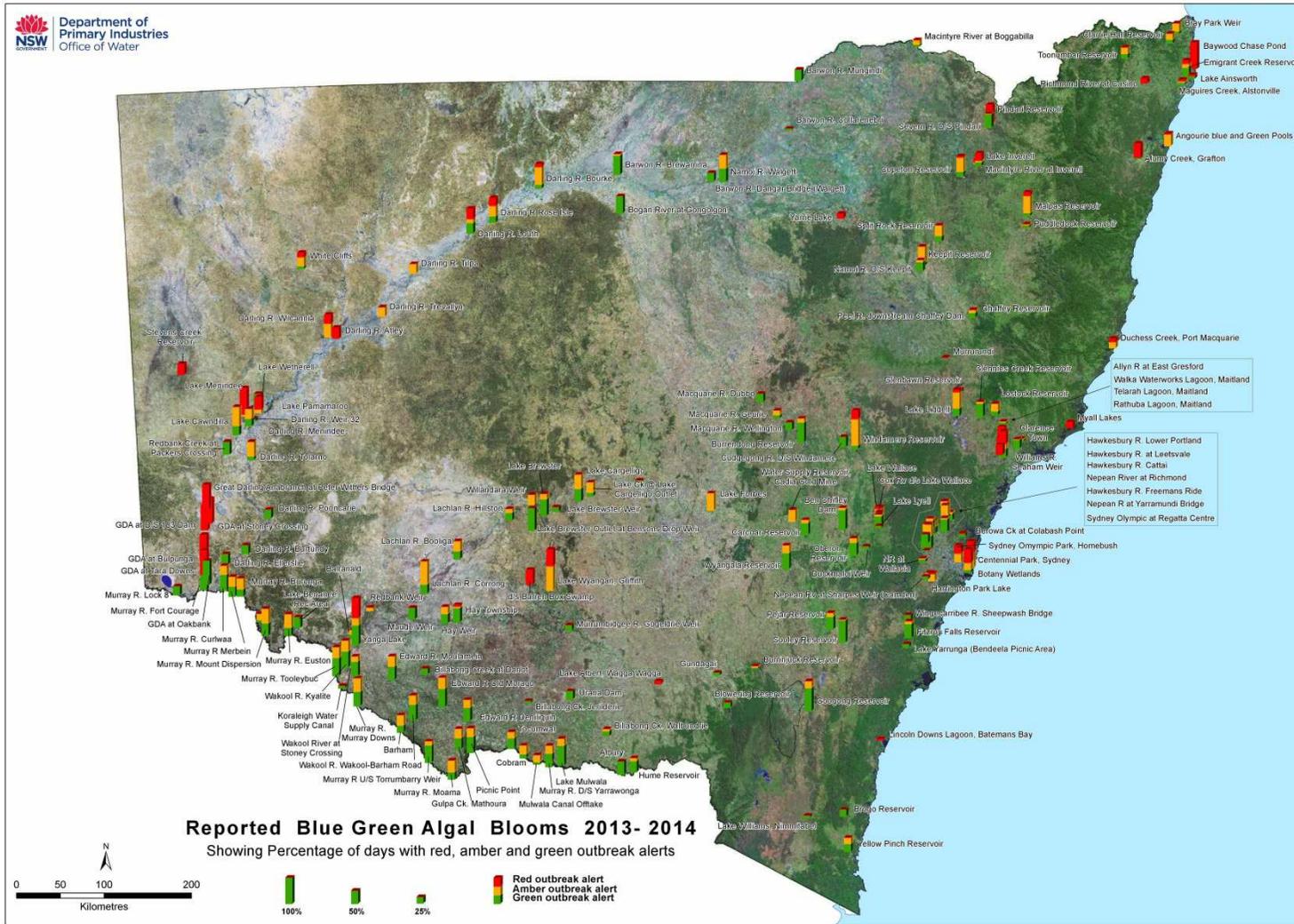


# Occurrence in NSW

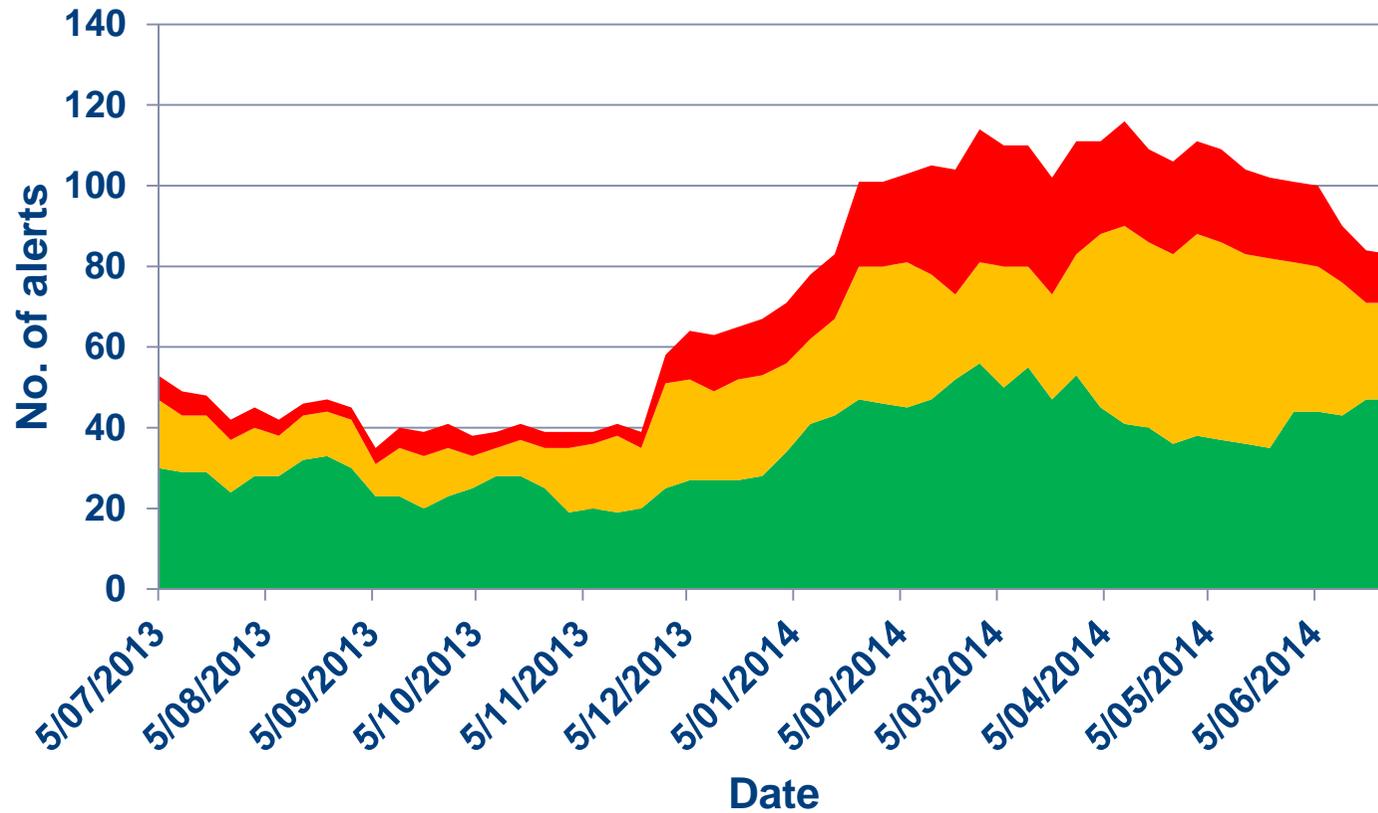
- Blooms can occur in freshwaters almost anywhere in the state
  - Both in coastal catchments e.g. Hunter, and in Murray Darling Basin
- Common in water supply reservoirs, both large irrigation impoundments and in small town water supply reservoirs
- Common in some small urban wetlands
- Sometimes major blooms in NSW rivers – e.g. Murray River blooms in 2009 and 2010
  - Warm water, low flows due to drought, contamination from headwater reservoirs



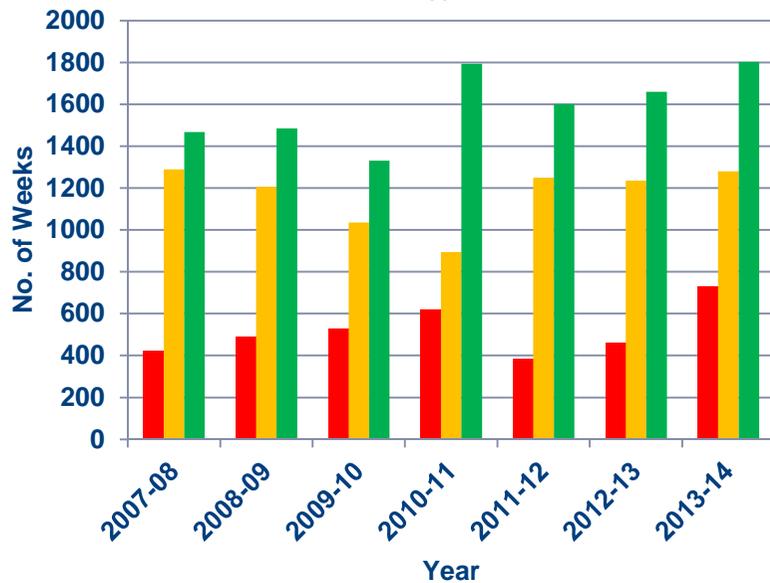
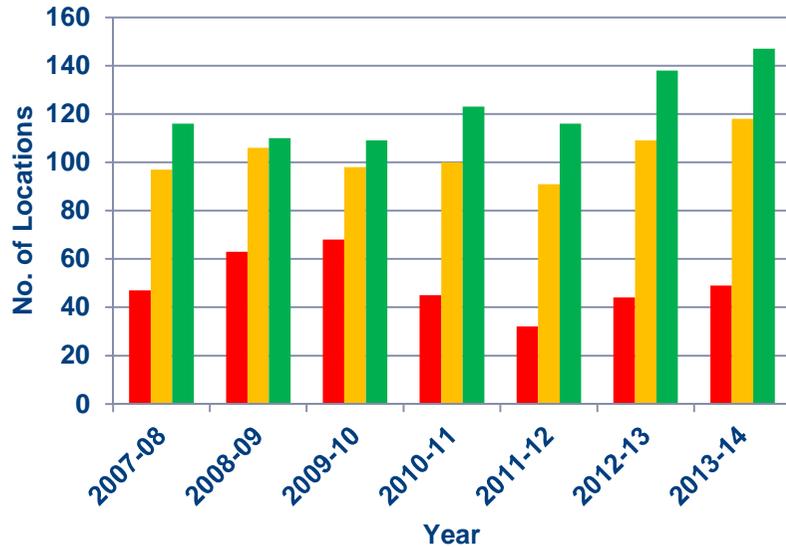
# Blooms in 2013-14



# Bloom occurrence, 2013-14



# Has bloom frequency increased?



- Noisy data due to variation in annual sampling effort and reporting by some data suppliers.
- End of Red alerts may not be notified by some agencies
- On a statewide basis, some variation in bloom occurrence and duration between years for the past 7 years, but a trend of increasing or decreasing blooms cannot be determined
- Some regional trends – fewer blooms in western NSW in wet years as blooms there mostly occur in rivers, compared to blooms in reservoirs or urban wetlands elsewhere



# Problems caused by blooms

- Unsightly green or coloured water
- Algal scums
- Physico-chemical problems – oxygen depletion and associated mobilisation of iron, manganese, nutrients, noxious gases (e.g. H<sub>2</sub>S)
- Taste and odour
- Contact irritants
- Toxins – hepatotoxins, neurotoxins, BMAA (?) – tumour promoters. Human fatalities attributed to cyanobacterial toxins overseas.



# Main problem species in NSW

- *Microcystis aeruginosa*
- *Microcystis flos-aquae*
  - Both produce hepatotoxins (microcystin)
- *Dolichospermum circinale* (*Anabaena circinalis*)
  - Produces neurotoxins (saxitoxin)
- *Cylindrospermopsis raciborskii*
- *Chrysochlorum ovalisporum* (*Aphanizomenon ovalisporum*)
- *Chrysochlorum bergii* (*Anabaena bergii*)
  - Produce cytotoxins (cylindrospermopsin)
- All cyanobacteria may produce contact irritants and BMAA



# Monitoring cyanobacteria

- NSW Office of Water monitor cyanobacterial presence at 72 sites on NSW rivers, most within the Murray Darling Basin
- State Water Corporation monitor 18 major headwater reservoirs along the Great Dividing Range, 3 off-river storages in Murray Darling Basin
- Sampling is usually monthly in winter (low cyanobacterial risk), fortnightly in summer, weekly during blooms.
- Assessment based on microscopic identification and counts of major taxa (to species if possible for potentially toxic taxa), counts converted to biovolume using standard cell sizes, then comparisons made with various water use guidelines.
- Toxin analysis or testing for the genes responsible for toxin synthesis not routinely used, but potential exists for their introduction
- Many Councils, Regional Water Utilities and other organisations also undertake their own monitoring programs



# An Alert Levels Framework for raw waters sourced for potable supply

- Signed off for use by NSW water utilities by the State Algal Advisory Group
- Recommended use only, not obligatory
- Available on-line from Water Research Australia website
- *Management Strategies for Cyanobacteria (blue-green algae): a Guide for Water Utilities*. Research Report No. 74. Gayle Newcombe *et al.* (2010) – Tables 9 and 10
- 4 Alert Levels – Low, Medium, High, Very High – based on how much cyanobacteria is present in the source water and the risk these present
- Provides management advice for each alert level

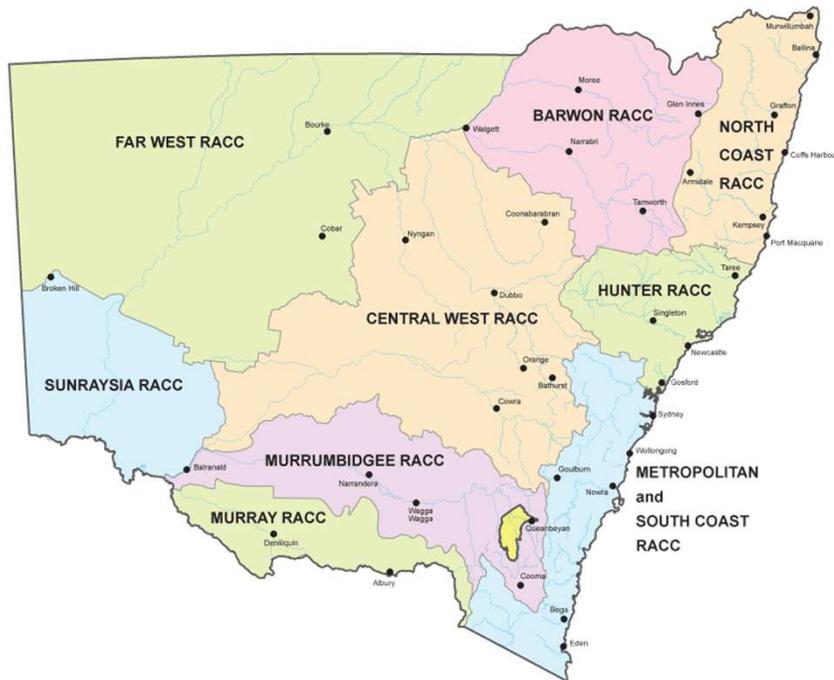


# Australian Drinking Water Guidelines

- “End of tap” guidelines rather than source water guidelines
- There are no guidelines in the ADWG based on cell counts or biovolumes.
- Guidelines only for the toxin microcystin in drinking water and “Initial health alerts” for saxitoxins, cylindrospermopsin and nodularin.
- Part V of the ADWG provide fact sheets on these toxins and details for notification procedures for blooms of *Microcystis aeruginosa*, *Dolichospermum circinale*, *Cylindrospermopsis raciborskii* and *Nodularia spumigena* that are identical to those in the Water Research Australia Technical Report 74 described previously



# Regional algal management



- 9 Regional Algal Coordinating Committees across NSW
- Provide advice and algal alerts to the public based on NHMRC (2008) recreational water quality guidelines – Green, Amber and Red.
- Higher alert thresholds than ALFs for raw water for potable supply
- Red alert implies that the water is not suitable for recreational purposes
- If recreational guidelines are exceeded, so too are all other guidelines for other water uses



# Management of blooms

- Response management - for waters where there is public access - issue a Red alert, media release and erection of warning signs.
- Town water supplies - Powdered Activated Carbon (PAC) commonly used in water treatment plants to remove toxins, taste and odour compounds. Cells are removed through normal water treatment processes (flocculation, filtration).
- Algicides – applied to blooms in source waters, infrequently used in NSW, a licence is needed to apply chemicals to any surface water
- Artificial destratification – used in some reservoirs in NSW, better success in small reservoirs
- Nutrient management – control of point source nutrient inputs, reduction of diffuse source nutrient pollution through catchment management, wetlands, riparian buffer strips, stock and erosion control
- Flow management – maintain sufficient flow in rivers, environmental flow releases



# Conclusions / Recommendations

- It is recommended that Councils and regional water utilities implement a monitoring program of their raw source waters, especially if cyanobacterial blooms have been recorded there in previous years.
- Monitoring should take place at least during the warmer months of the year when conditions are more suited to cyanobacterial growth.
- If toxin monitoring is not possible, then cyanobacterial cell numbers or biovolume presence can be used as a surrogate to provide an estimate of potential risk posed by blooms.
- Management interventions such as use of activated carbon may be necessary if the ADWG toxin guidelines or “initial health alerts” are exceeded, or if cell counts of known toxin producers in raw source waters exceed the Alert Level 2 thresholds outlined in the Water Research Australia Alert Levels Framework
- Further advice on health risk and water treatment can be obtained from NSW Health and from the Urban Water Branch of the NSW Office of Water.
- Waters not used as a source for potable supply but where there is public access should be managed according to the NHMRC (208) recreational water quality guidelines.

