# BLOOMING BLUE-GREEN ALGAE – ARE YOU READY?


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## ABSTRACT

The 2016 blue-green algae (BGA - cyanobacteria) bloom affecting the Murray River demonstrated the need for a coordinated, whole of government approach when dealing with a bloom affecting multiple states and regions in Victoria. The response arrangements and communication of key messages was complicated by the unpredictable nature of the BGA bloom and uncertainty around the potential impacts of BGA toxins to public health. The detection of a species of BGA not previously found in Victoria, *Chrysosporum ovalisporum,* highlighted the ever evolving complexity of bloom dynamics. This species has the ability to produce toxins, however the factors influencing toxin production are not well understood and toxin production therefore cannot be easily detected, quantified or predicted. The Department of Health and Human Services is reliant on the best available science to inform decisions and the provision of timely, evidence based advice when dealing with potential risks to public health. Due to the complex and unpredictable behaviour of blooms, water suppliers and water storage managers require agility in their response and robust and resilient water supply systems. As we continue to encounter variable climatic conditions and issues relating to water scarcity, BGA blooms are likely to be an ongoing risk to water quality into the future.

## 1.0 INTRODUCTION

In the summer of 2016, after hotter than average temperatures, an unprecedented BGA bloom developed in the Murray River, spanning over 1330 kilometres from the Hume Dam to Mildura between February to June 2016. The Victorian Department of Health and Human Services (DHHS) Water Program was alerted to this bloom when levels of BGA exceeded the drinking water and recreational water alert levels outlined in the Victorian *Blue-Green Algae Circular 2015-16 - Coordination Framework* (Department of Environment, Land, Water & Planning 2015). The bloom impacted two states, two Victorian regions, 26 drinking water treatment plants and six Victorian water agencies.

The novel feature of this bloom was the dominant species, *Chrysosporum ovalisporum,* which had never been detected in previous blooms affecting the Murray River. Although it is known that *Chrysosporum ovalisporum* is a potentially toxin producing species, little is known about the mechanisms involved and associated stressors inducing toxin production. This added complexity to the management of the bloom, with unknowns relating to the potential public health risks associated with this poorly characterised species of BGA.

A whole of government approach is required when dealing with BGA blooms that impact multiple divisions across Victoria. The Victorian response arrangements for BGA blooms in the Murray River are well established and outlined in the *Victorian Blue-Green Algae Circular,* overseen by the Department of Environment, Land, Water and Planning (DELWP). While New South Wales (NSW) manages the Murray River, blooms in the river affect both NSW and Victoria, with the public from both states using the river for recreational purposes and water agencies using the river water as a drinking water source. In 2009 and 2010 BGA blooms in the Murray River were managed by the Murray Regional Algal Coordinating Committee (MRACC) through implementation of the Murray Regional Algal Contingency Plan and the Victorian *Blue-Green Algae Circular*. The MRACC is led by the NSW Department of Primary Industries.

A new approach was taken during the 2016 bloom to manage the widespread impacts of BGA impacting the Murray River. Uncertainty regarding the potential health risk relating to the dominant species of BGA, along with the large geographical area affected and involvement required from multiple agencies, influenced the decision by DELWP to define the bloom as a Class 2 Emergency as per Victoria's *Emergency Management Act 2013*. This approach brought together a large number and broad range of stakeholders and resources in a collaborative response, along with a greater emphasis on relief and recovery.

**Figure 1:** ***Image of the Murray River at Barmah in March 2016 showing visible green colouring of the water due to elevated levels of BGA***

## 2.0 DISCUSSION

Water agencies take water from the Murray River and undertake treatment to ensure that the water is safe for drinking. While the structure of the emergency response to the 2016 bloom was new, the key actions undertaken by water agencies in response to a BGA bloom remained largely unchanged.

Victorian water agencies regularly monitor for BGA presence and levels (cell biovolume) as part of their standard water sampling regimes. Goulburn Valley Water initially identified the increasing levels of BGA in February 2016 from Murray River samples taken at their Cobram and Barmah water treatment plants. The Murray Regional Algal Coordinating Committee and DHHS were notified on 19 February of these elevated levels, resulting in the Murray Regional Algal Coordinating Committee issuing a media release on 23 February 2016 advising of the bloom between Cobram and Barmah. This advice was revised on 25 February 2016 when water sampling results indicated that the bloom had extended from the Hume Dam to Torrumbarry Weir (downstream of Echuca).

As part of the emergency management response, Emergency Management Victoria - who were responsible for overseeing coordination of the emergency response - initially set up an Incident Control Centre (ICC) in the Hume region. Water sampling results received during the BGA bloom by both Victorian and NSW agencies were collated at the Hume ICC, then shared with all stakeholders involved in responding to the bloom.

There were over 150 water quality monitoring sites utilised between Hume Dam and Murrabit during the bloom, which increased significantly when the bloom extended to Mildura. Victorian drinking water suppliers undertook weekly sampling to verify the species and biovolume of BGA. As *Chrysosporum ovalisporum* is known to be potentially toxin producing, weekly toxin testing was also implemented by water agencies. The frequency of toxin testing was informed by cell biovolumes in the raw water at water treatment plants along with general surveillance.

As part of water agency's risk management planning, additional treatment options were implemented to address potential water quality risks associated with BGA. These additional treatments were implemented in response to increasing BGA biovolumes prior to the bloom occurring. Additional water sampling was carried out pre and post water treatment to verify the effectiveness of the treatment processes. In some instances, some smaller water treatment plants were unable to treat the water adequately due to elevated BGA concentrations in the Murray River. Where this occurred the water agency implemented contingency plans and carted safe drinking water from a reliable drinking water supply to ensure that communities had access to safe drinking water. This option was possible for smaller water treatment plants servicing small towns. It was noted that additional contingency planning may be required for larger supply systems where existing treatment processes may not be adequate in managing the BGA bloom and carting water to larger townships are not feasible.

As the bloom expanded downstream affecting a second Victorian region, an ICC was also set up in the Loddon-Mallee region. The two regional ICC's allowed for coordination of regional and local response activities which fed into the State emergency management arrangements. In addition to the impact on Victoria and NSW, our South Australian colleagues were busy preparing and monitoring the waterway downstream of Mildura.

## 2.1 The need for agility and resilience when responding to BGA blooms

BGA blooms are likely to occur more frequently during variable climatic conditions resulting in increased water temperatures, decreased river flow and increased agricultural nutrient run off, as encountered in this bloom can be unpredictable in nature. Blooms are now occurring in Victoria where they would not normally be expected and have not previously occurred, extending into the winter months. Stakeholders responsible for responding to BGA blooms need to be vigilant and plan for the unexpected.

Further research to better understand the influencing factors of BGA blooms, the genetic nature of particular species and characteristics in potential toxin production will inform future planning and implementation of adequate and timely mitigation measures.

The 2016 Murray River bloom had the potential to affect human health, animal health (including livestock), drinking water supplies, agriculture, tourism industries, small business and local economies. A collaborative partnership across the diverse group of stakeholders is needed to enhance future preparedness for the potential increased prevalence of BGA blooms.

## 2.2 Preparedness and contingency planning

Water agencies manage risks relating to drinking water supplies and recreational water through risk management planning, BGA preparedness and contingency arrangements. Coordination of information and communication of risk between all stakeholders will continue to present a challenge, requiring a planned and collaborative approach.

Victoria's *Safe Drinking Water Act 2003* requires water agencies to prepare, implement and review risk management plans in relation to the provision of safe drinking water. Water agencies that face the risk of BGA affecting their drinking water supplies manage these risks as part of their day to day business. Contingency planning in response to BGA is also part of their routine business. As previously stated, additional treatment barriers are often part of contingency planning, but this is not always available or practical at some treatment plants.

Due to the nature of BGA speciation, toxin testing and the unknowns relating to toxin production and concentration, there is a need to respond to blooms in the absence of sampling results. As toxin testing results take some time to receive (up to 10 days in some instances during the 2016 Murray River bloom), water agencies needed to introduce additional water treatment to remove potential toxins from the water. This mostly involved the addition of powdered activated carbon (PAC); this was also utilised in some instances to improve the aesthetic quality (taste and odour) of the water where affected by the presence of BGA. During the peak of the bloom all affected drinking water suppliers had incorporated the addition of PAC treatment (where able to do so) to address the potential presence of toxin, with mobile PAC plants being utilised also.

No single water sample was positive for BGA toxin in relation to the 2016 Murray River bloom. However, the presence of a potential toxin producing species at elevated levels, along with the unpredictable nature of BGA, required water agencies to adopt risk proportionate actions to mitigate potential public health risk.

Water agencies are required to document the risks associated with BGA in their risk management plans; these should be updated as new risk management options come to light, and regularly reviewed for accuracy.

## 2.3 Clear communication is paramount

The *Victorian Blue-Green Algae Circular* and related regional plans outlines the communication pathway between existing stakeholders. The Victorian emergency management framework increased the level of complexity in communication due to the diverse group of stakeholders involved which extended beyond the existing plans for managing BGA blooms.

The 2016 BGA bloom involved an Incident Controller from Emergency Management Victoria (EMV), with the response being led by DELWP and the relief and recovery phases led by DHHS.

Blue-green algae represents a risk to recreational users of affected water through skin contact, via mechanisms disassociated with the presence of toxin/s. Clarity relating to public messaging of these two distinct exposure risks proved a challenge, along with all facets associated with each exposure route including the consumption of fish, mussels, yabbies and crayfish which are commonly collected by recreational fishers. Simplified messages to the public warning of health risk and mitigating actions are essential to ensure that they're understood; this messaging is particularly difficult when relating to complex issues such as BGA blooms. Throughout the duration of this bloom, DHHS ensured that health messaging originated from a central point of truth, ensuring consistent, evidence-based messaging was disseminated to all stakeholders.

BGA blooms are unpredictable and highly variable depending on a wide range of factors that contribute to cell growth. The presence in the 2016 Murray River bloom of a novel species that was potentially toxin producing, along with the bloom spanning a large geographical distance requiring involvement from numerous agencies, provided additional challenges to management of response activities. The presence and duration of blooms are affected by environmental factors that cannot be controlled; the 2016 Murray River bloom persisted from February 2016 through to June 2016, affecting over 1330km of waterway. Water agencies should continue to address future potential water quality risk through their regular risk management plan process. Collaborative research is needed to further understand the fate of novel BGA to proactively minimise its prevalence in the environment and enhance stakeholder preparedness.

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- Lower Murray Water
- Murray Regional Algal Co-ordinating Committee
- North East Water

## 5.0 REFERENCES

DELWP (2015) *Blue Green Algae Circular 2015-16 - Coordination Framework*, Department of Environment, Land Water and Planning, State of Victoria.