Blue-green Algae Recreation Management Procedure summary

seqwater
WATER FOR LIFE

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Translation and interpreting assistance

Seqwater is committed to providing accessible services to people from culturally and linguistically diverse backgrounds. Please contact us and we will arrange an interpreter to share this publication with you.

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Contents

Introduction

Seqwater is responsible for providing a safe, secure and cost-effective drinking water supply for more than three million people across South East Queensland.

We are one of the few bulk water providers in Australia that manages open catchments, allowing the community to enjoy our water storage lakes and catchment land for recreational activities. Our challenge is to balance community access with our essential role of providing high quality drinking water.

Public safety is our priority. We take a proactive and conservative approach to safety at our recreation areas, restricting access to water-based activities when there is a potential public health or safety concern due to microbial risks or the presence of cyanobacterial toxins.

Cyanobacteria (commonly referred to as blue-green algae) are naturally occurring organisms and are amongst the earliest known life forms on this planet, believed to be partly responsible for the development of life through the oxygenation of the earth's atmosphere.

Blue-green algae can exist in both salt and fresh water, and are an important part of a healthy ecosystem, performing functions such as photosynthesis, nitrogen fixation and nutrient cycling in the food chain. Blue-green algae are also sometimes used to grow food, make fertilisers and convert solar energy.

Despite their beneficial functions, blue-green algae can sometimes pose significant risks to human health and our lifestyle by producing toxins and odorous compounds.

A number of guidelines and protocols are in place to help water authorities protect recreational users from risks related to blue-green algae exposure, including the:

- *Australian Drinking Water Guidelines*
- *Australian Guidelines for Water Quality Monitoring and Reporting, and*
- *Guidelines for Managing Risks in Recreational Water and Management Strategies for Cyanobacteria (blue-green algae): a guide for Water Utilities.*

Seqwater's *Cyanobacterial Management Plan* and *Alert Level Framework for Cyanobacteria and Recreation Procedure* provides an overarching framework and uniform process for managing blue-green algae risks to recreational users at our water storage lakes. We have embraced national protocols and standards, and developed local water quality guidelines that apply to the 17 water storage lakes in South East Queensland where water-based recreation is permitted.

About
Blue-green algae

Fresh water blue-green algae are photosynthetic and have unique characteristics that enable them to dominate their environment under favourable water conditions.

They can be a single cell, an aggregation of cells (colonial), a solitary filament (or thread) or filament clumps. Some species are also capable of nitrogen fixation (which makes them very important in the nitrogen cycle), and many can regulate their buoyancy to take advantage of optimal light and nutrient conditions. Toxic strains may be resistant to being eaten by their competitors.

CONTRIBUTING FACTORS TO GROWTH

Blue-green algae can bloom quickly under the right environmental conditions, when there is abundant sunlight, warm temperatures, still water and sufficient levels of nutrients, especially nitrogen and phosphorus.

Nutrients are either naturally present in sediments or are washed into the lake from the surrounding catchment (agriculture, sewage effluent and stormwater run-off). Trapped sediments in lakes can provide an ongoing source of nutrients for repeated algal growth.

Other contributing factors may include the number of aquatic animals in the lake that eat algae, and heavy rainfall.

WEATHER

Periods of warm, sunny days with light winds are most favourable for cyanobacterial growth, although high levels of blue-green algae are known to persist through winter.

VISIBLE AND INFRARED LIGHT:

Still and stagnant water bodies are great for algae growth. Algae are able to absorb the sunlight they need to grow and make their own food. In Seqwater lakes, stratification of the water is common during the spring, summer and autumn months. This usually means warm water in the top layer of the lake and cold water at the bottom. Clear, calm and warm conditions mean the light and heat from the sun can penetrate deeper into the water, creating a large area for growth above what is called a thermocline. A thermocline occurs when heat from the sun warms the surface layers of a water storage, which then changes the water's buoyancy and results in an abrupt temperature gradient as the warm surface layer floats on top of the cooler, more dense bottom water. This commonly occurs in Seqwater storages at depths from several metres to 20 metres.

NUTRIENT LEVELS:

Many lakes and waterways are enriched with naturally and anthropogenic (human) derived sources of nitrogen and phosphorus, which aid algae growth. The greater the levels of nutrients dissolved in the water, the greater the probability of algal blooms forming. Recent research in South East Queensland indicates that higher nutrient levels may favour the preferential growth of toxic strains of cyanobacteria, over non-toxic strains.

ALGAE PREDATOR NUMBERS:

Zooplankton, crustaceans, mussels, and aquatic insects all eat algae. If water quality is poor and the number of these animals drops, there is less grazing pressure on the algae. Algae may grow in large numbers in the absence of predators.

RAINFALL:

Moderate to severe rainfall events can remove nutrient-rich top soils and materials from the catchments, depositing them in the streams and rivers of the upper catchment, where there are no or limited riparian buffers. This sediment transport provides a nutrient source which increases the risk of algal blooms

Algal blooms **in our lakes**

FUTURE CLIMATE CHANGE

Future climate variability, such as higher temperatures and changes in rainfall patterns, is predicted to affect a number of parameters that impact algal populations. It has been suggested that measurable increases in global air temperature, coupled with increased fluxes of nutrients from agricultural run-off, stormwater, or sewage treatment plants and other anthropogenic (human) sources, favour the growth of cyanobacteria, including toxin-producing taxa. Higher water temperatures are predicted to have a direct positive effect on blue-green algae growth rates by strengthening and intensifying water stratification and giving blue-green algae populations a competitive advantage over other species. Rainfall events are predicted to occur at higher frequencies and intensities, with longer periods of drought between events.

Since Seqwater began its algae monitoring program, population numbers and the duration of blooms have continued to increase. This is an emerging human and environmental health concern.

HELPING TO PREVENT BLUE-GREEN ALGAL BLOOMS

As a community, we can help prevent blue-green algal blooms by limiting the amount of nutrients in the water and promoting ecological health. Detergents and fertilisers contain a high concentration of nitrogen and phosphorus, so we can all play our part by:

- preventing nutrients from washing into roadside drains that flow into local waterways, e.g. by washing the car on the lawn rather than on the road
- using phosphorus-free detergents
- reducing the use of fertilisers where possible
- helping to rehabilitate waterways
- preventing land erosion, where possible, to stop soil washing into waterways.

Across South East Queensland, we expect blue-green algal blooms to reoccur every year with varying severity. They can persist for weeks, months and even an entire season if conditions are favourable.

Blue-green algal blooms, and in particular potentially toxic species, can pose significant risks to human health through the production of toxins. The dominant species during bloom events in nearly all Seqwater lakes is Cylindrospermopsis raciborskii, which produces a toxin called Cylindrospermopsin.

Blue-green algae **toxins**

Blue-green algae can produce toxins (known as cyanotoxins) which affect people and animals that swim in, drink from, inhale aspirated sprays of, or come into contact with contaminated water.

In the natural environment, toxins are generally contained within the blue-green algal cell but are released into the water when cells are damaged or die.

Cyanotoxins can be classified into four families according to the organs on which they act:

- neurotoxins (nervous system)
- hepatotoxins (liver)
- cytotoxins (several organs: liver, kidneys, adrenal glands, small intestine)
- endotoxins (irritant toxins).

NEUROTOXINS:
These toxins are more common in New Zealand river systems. They act as neuromuscular blocking agents and can cause death by paralysing peripheral skeletal muscles, then respiratory muscles, which leads to respiratory arrest. Neurotoxins are produced by species of *Aphanizomenon, Dolichospermum Nostoc* and *Oscillatoria*.

HEPATOTOXINS:
These are the most common of the blue-green algae toxins. They attack the liver and other internal organs. Common symptoms of exposure include visual disturbances, gastroenteritis, nausea, vomiting and muscle weakness. They can be produced by such species as *Cylindrospermopsis, Dolichospermum Microcystis, Nodularia,* and *Oscillatoria* and are slower acting than neurotoxins.

CYTOTOXINS:
The alkaloid cylindrospermopsin is known as a general cytotoxin that blocks protein synthesis in mammal cells. The protein blocking can occur in multiple organ systems including the liver, kidney, gastrointestinal tract, heart, spleen, thymus and skin. They can be produced by such species as *Aphanizomenon, Cylindrospermopsis, Dolichospermum, Raphidiopsis* and *Umezakia*.

ENDOTOXINS:
The outer walls of all blue-green algae contain lipopolysaccharides, which can act as a contact irritant and cause severe dermatitis and conjunctivitis in people coming into contact with the algae through swimming or water spray. They have also been known to cause nausea, stomach cramps, fever and headaches. If swallowed, they may irritate airways and cause breathing difficulties.

In nearly all Seqwater storages, the dominant species during bloom events is *Cylindrospermopsis raciborskii* which produces a toxin called Cylindrospermopsin. This toxin blocks protein synthesis and can severely impact the kidneys and liver.

Seqwater maintains a broad toxin screening program to monitor emergent cyanobacteria and their associated toxins.

Exposure to cyanotoxins **and health risks**

Exposure to blue-green algae toxins can be through:

- accidental or deliberate swallowing of affected water
- inhalation of water droplets or aerosols (water-skiing), or absorption through nasal and pharyngeal mucous membranes in water sports involving submersion of the head (swimming, jumping from diving boards, sail boarding, and canoe capsizing)
- direct water contact with the skin, including sensitive areas such as the ears, eyes, mouth, and nose
- excessive consumption of fish or crustacean flesh and organs from affected waters.

Various toxins released by some species of blue-green algae can present a health risk to people and animals when they are ingested, inhaled or come into direct contact with the skin. Swallowing water containing toxins may cause gastroenteritis symptoms, such as nausea, vomiting, diarrhoea and abdominal pain, or fever, headache, muscle weakness, pneumonia and paralysis.

The toxins produced by blue-green algae may also affect multiple internal organs and the nervous system. Inhaling affected water may cause respiratory problems and flu-like symptoms. Skin contact with the water, especially sensitive areas such as the eyes, ears, nose and mouth, may cause ear and eye irritation, skin rash, flu-like symptoms and fever. The risk of developing these symptoms is likely to grow as contact time increases.

If you are concerned about your health after contact with affected water, seek medical advice.

Note: Boiling algae-affected water will not destroy toxins. Boiling will kill algae, but in doing so will release more toxins into the water.

CONSUMING FISH OR CRUSTACEAN FLESH AND ORGANS FROM ALGAE-AFFECTED WATER

Consuming excessive amounts of fish, shellfish or crustaceans caught in algae-affected water may present a health risk. The identification of Paralytic Shellfish Poisoning (PSP) toxins in one of the species of blue-green algae in Australia has highlighted concerns about possible neurotoxin bioaccumulation in edible fish, mussels and other shellfish.

In marine waters, consumption of shellfish contaminated by PSP has caused many human deaths. Cylindrospermopsin, another blue-green algal toxin common in fresh water in Queensland, has been identified in the edible flesh of crayfish. For consumption guidance see **Fish consumption guidance from Queensland Health** on page 10.

If you experience symptoms, or are concerned about your health, seek medical attention.

RISKS TO CHILDREN

Children are more susceptible to the effects of toxins due to their lower body weight. There is also a greater risk of children and young adults engaging in activities where water is likely to be swallowed or inhaled, without knowing or understanding the risks associated with cyanotoxins. Children should always be supervised by adults when swimming or participating in any activity in any body of water. As children have more sensitive skin than adults, they are also more likely to suffer from skin rashes associated with endotoxin exposure.

Recreation at Seqwater **storage lakes**

More than 2.5 million people visit Seqwater's water storage lakes every year. Seqwater's Recreation Management Framework sets out our objective and principles for managing access to recreational opportunities while protecting natural resources and water quality.

A range of recreational activities are available at 20 Seqwater lakes across South East Queensland. Seventeen of these lakes offer water-based recreation.

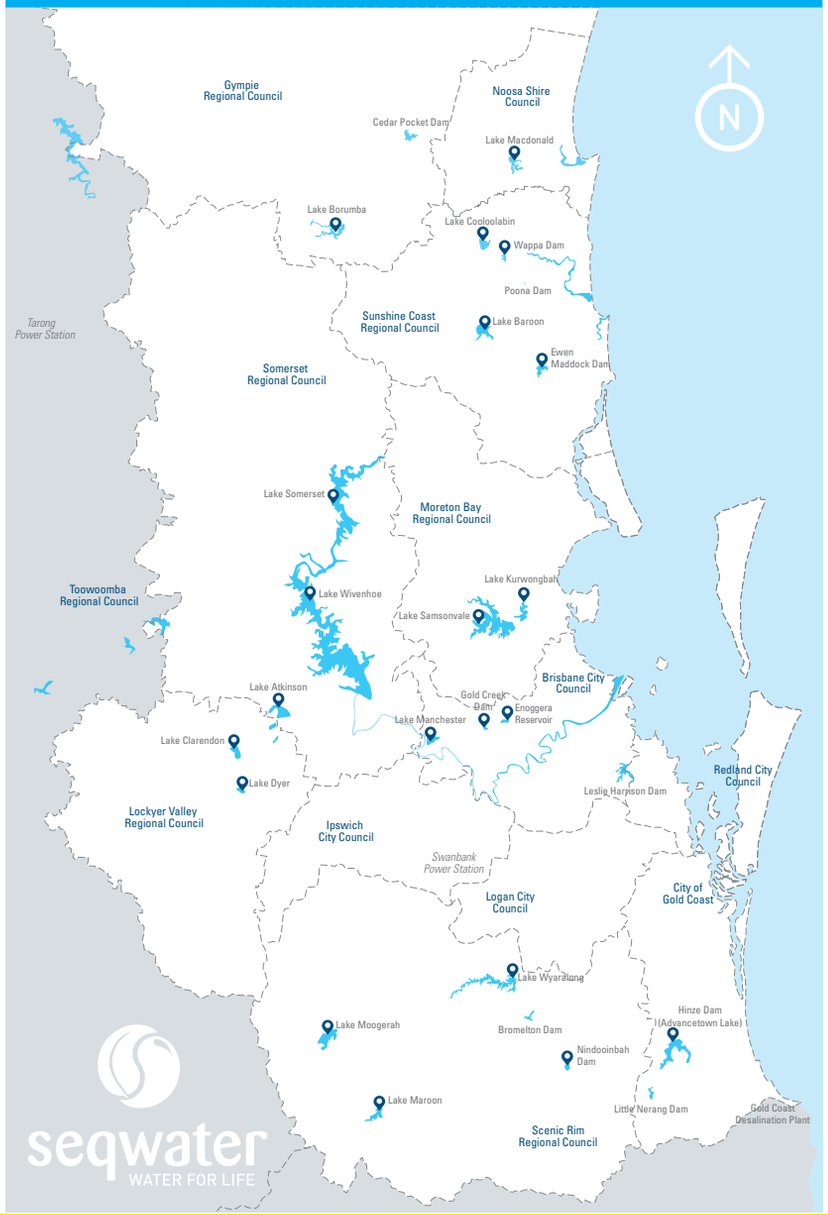
PRIMARY AND SECONDARY CONTACT RECREATION

Water-based recreation activities are classed as primary contact (in-water) or secondary contact (on-water):

- **Primary contact (in-water) recreation** involves water contact activities where the whole body, face and/or trunk is frequently immersed; or where the face is constantly being sprayed; or where it is likely that some water will be swallowed, inhaled, or come into contact with the skin, ears, eyes, mouth and nose (e.g. swimming, water-skiing, jet-skiing, tubing).

- **Secondary contact (on-water) recreation** involves incidental water contact activities in which only the limbs are regularly wet, and greater contact with water (including swallowing) is unusual (e.g. boating, fishing, rowing, kayaking or canoeing with no intent to capsize or submerge). There may be the occasional and inadvertent immersion through accidents (e.g. slipping into the water, accidentally capsizing from a rowing or sailing craft).

Storage lakes in South East Queensland



Monitoring
blue-green algae

Seqwater has an extensive water quality monitoring program, which was developed for South East Queensland conditions, taking into account state and national advisories.

We have partnered with researchers to better understand blue-green algal blooms and their toxins. We are also working to improve the health of our lakes and catchments by reducing nutrient and sediment input from the surrounding land and improving ecosystem function.

We regularly monitor our water storages for algal blooms and restrict water-based activities when algae toxin levels indicate a health risk. We make this assessment through toxin testing—analysing the amount of toxins which have dissolved in the water—and use toxin concentration as the primary indicator for health risks.

It is important to note that the presence of scum takes priority over reported cyanotoxin levels. When scum risk is identified as medium and low, priority is given to toxin concentration levels for recreational lake management.

Research has shown that toxin production may vary from week to week during a bloom, depending on the dominant species and the amount of cell death and toxin release.

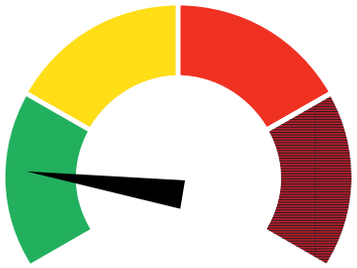
The triggers for restricting water-based recreation activities are detailed in the following table.

Recreational toxin triggers					
Cyanotoxin	**Unit**	**Low level**	**Medium level**	**High level**	**Extreme level**
Microcystin	ug L^{-1}	< 3	≥ 3	≥ 10	≥ 25
Saxitoxin	ug L^{-1}	< 9	≥ 9	≥ 30	≥ 75
Cylindrospermopsin	ug L^{-1}	< 3	≥ 3	≥ 10	≥ 25
Nodularin	ug L^{-1}	< 4	≥ 4	≥ 13	≥ 30
Anatoxin-a	ug L^{-1}	< 3	≥ 3	≥ 10	≥ 25

Note: ug L^{-1} = micrograms per litre. Toxin concentration in the lake is measured in units, by the amount of toxins (microgram) per volume of water (litre).

Alert levels **for recreation**

Blue-green algae alert levels describe an established cyanobacterial population, and the toxin concentration levels in the lake that pose health risks for people who swim, ski, boat and fish at Seqwater storages.



Current alert level:

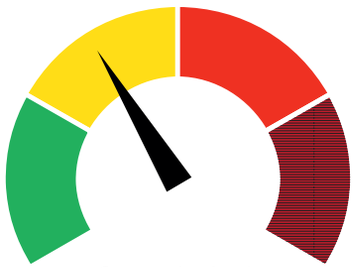
Low

Total cyanobacterial toxin concentrations are less than low level concentrations in the recreational toxin triggers table.

The presence of toxin producing blue-green algae is very low. Other non-toxic strains and species may be present, making the water look green.

Lake is open for all permitted water-based activities at this level, as algae levels are unlikely to cause adverse health effects.

Seqwater will maintain routine water quality monitoring.



Current alert level:

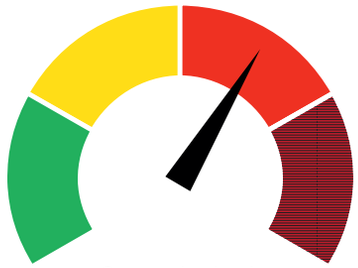
Medium

Toxin levels exceed low level conditions but not enough to close lakes to primary recreation.

There is an increase in algae toxin concentration.

Lake is open for all permitted water-based activities.

Seqwater will monitor water quality and increase the frequency of toxin testing to fortnightly.



Current alert level:

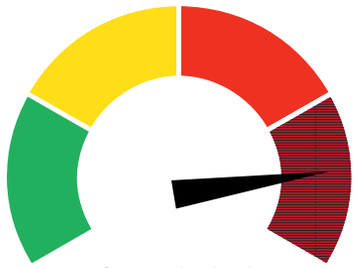
High

Toxin concentrations exceed high level conditions.

High levels of blue-green algae toxins are present in the lake and pose serious health risks if people swallow, inhale or come into contact with algae-affected water (including sensitive areas such as the ears, eyes, mouth and nose).

Lake is closed to primary contact (in-water) recreation, but remains open for secondary contact (on-water) recreation.

Seqwater will conduct weekly water quality tests and re-open the lake to primary contact recreation when two consecutive water quality test results fall within acceptable limits.



Current alert level:

Extreme

Toxin concentrations exceed extreme level conditions.

Exposure to extreme level blue-green algae toxins poses serious health risks if people swallow, inhale or come into contact with algae-affected water (including sensitive areas such as the ears, eyes, mouth and nose).

Lake is closed to primary contact (in-water) recreation and an advisory notice is issued for secondary contact (on-water) recreation, which recommends people do not engage in any water-based activities until levels fall within acceptable limits.

Seqwater will continue weekly toxin tests. The advisory notice for secondary contact (on-water) recreation will be lifted when two consecutive water quality test results fall within acceptable limits.

Restricting lake access for **water-based recreational activities**

Seqwater closes water storage lakes, or part of a lake, for primary (in-water) and/or secondary (on-water) contact activities when there is a risk to public health and safety.

When blue-green algae toxin concentrations reach trigger levels, we will issue lake closure notices and restrict all primary contact (in-water) recreational activities, including:

No swimming | No jet-skiing | No water-skiing | No tubing

If the toxin concentration continues to increase and reach extreme levels, lakes will remain closed to primary contact (in-water) recreation. Seqwater will also issue an advisory notice recommending people avoid secondary contact (on-water) activities, including:

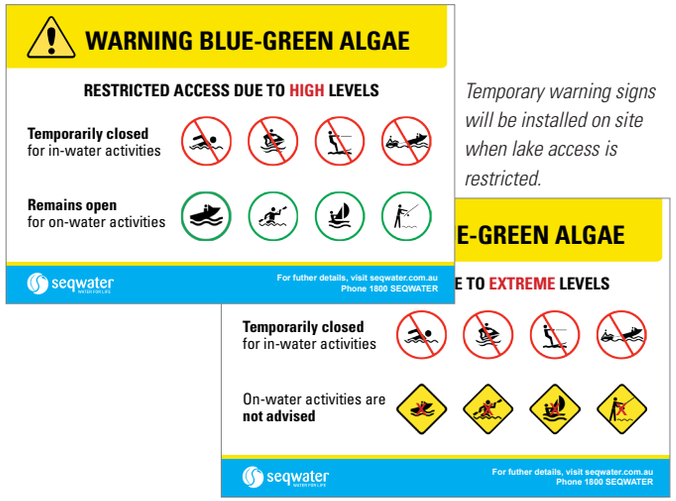
All boating not advised | Paddling not advised | Sailing not advised | Fishing not advised

When temporary closures or advisories are in place, signage is erected at lake entry and launch points, as well as at designated swimming areas. These signs show the current risk for recreational activities at a particular site. Information is also available on the Seqwater website, social media channels and via the Seqwater app. See **Keeping our communities informed** on page 11.

Relevant state departments, special interest groups and key stakeholders will be advised of any changes to alert levels, in line with Seqwater's Alert Level Framework for Cyanobacteria and Recreation Procedure.

It may be necessary to close lakes to primary contact (in-water) recreation for weeks or months, until algae levels return to acceptable limits.

At times, we may also close lakes to all water-based recreational activities (primary and secondary contact) for other reasons, such as severe weather.



Temporary warning signs will be installed on site when lake access is restricted.

Fish consumption advice **from Queensland Health**

Queensland Health advises that it is safe for people to eat two to three serves of fish per week. Pregnant women, women planning pregnancy and young children should limit their intake of shark, broadbill, marlin, swordfish and freshwater fish.

It is generally advised that pregnant women and women planning pregnancy should consume no more than 150 grams of these types of fish per fortnight, including canned fish. Children six years and under should consume no more than 75 grams a fortnight and other adults should consume no more than 150 grams.

For further guidance, refer to the Food Standards Australia New Zealand fact sheet at foodstandards.gov.au.

Keeping our **communities informed**

Blue-green algae exists in all waterways, producing toxins that may pose health risks at certain levels.

As part of our updated Blue-green Algae Recreational Management Procedure, we publish current blue-green algae levels for each of our recreation lakes on our website.

Plan ahead to play it safe when visiting any of our lakes. Check our recreation and safety notices before you leave home to ensure you are aware of the latest lake conditions and current closures.

Seqwater keeps the community informed of lake closures and blue-green algae levels through website updates, Facebook and Twitter posts, and signage. We will re-open lakes to primary contact (in-water) recreation as soon as water quality tests indicate it is appropriate to do so.

Download the Seqwater mobile app to receive notifications about lake closures or warnings as they occur.

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