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Department of Regional Development, Manufacturing and Water

Managing Harmful Algal Blooms (HABs) under the Drinking Water Regulatory Framework Queensland

26 October 2023

Acknowledgement of Country

The Department of Regional Development, Manufacturing and Water respectfully acknowledges the Traditional Custodians of Country. We recognise the ongoing spiritual and cultural connection Aboriginal peoples and Torres Strait Islander peoples have with land, water, sea and sky. We pay our deep respects to their Elders past and present, support future leaders, and acknowledge First Nations Peoples' right to self-determination.

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‘Blue Green Algae’ bloom

- An excessive growth of cyanobacteria species in water
- Cyanobacteria are photosynthetic bacteria, not a plant, although they are often referred to as ‘blue-green algae’ and ‘algal blooms’ because they resemble true algae.
- Excessive growth of cyanobacteria can impact water quality causing discolouration and the formation of scums, unpleasant tastes and odours, increase the operational costs (e.g., implementing growth and clogged filter control measures).

What are ‘Harmful Algal Blooms’

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- Some cyanobacteria can produce toxins (cyanotoxins) that are harmful to human health.
- It is difficult to tell the difference between a harmful algal bloom and a non-harmful algal bloom.
- Some species, however, release cyanotoxins into water, which may cause skin irritations and damage to the liver, kidneys/adrenal glands, lungs, heart, stomach and the vascular and lymphatic systems.
- It is not known what triggers cyanobacteria to produce cyanotoxins and release toxins.
- Animals, including farm stock are also susceptible to cyanotoxins. Dead and dying cattle in or near water, where ‘blooms’ are present, can be warning sign that cyanotoxins may have been released.

Harmful Cyanobacteria Species

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ADWG – Section 5.6 (Chapter 5)

Table 5.8 Cyanobacteria of concern in Australian drinking water

Toxin	Cyanobacteria species	Disease
Cylindrospermopsin	*Raphidiopsis raciborskii* (Woloszynska) (formerly known as *Cylindrospermopsis raciborskii*), Chrysosporum (formerly Aphanizomenon) ovalisporum	Damage to liver, kidneys, lungs, heart, stomach, adrenal glands, the vascular system and the lymphatic system
Microcystins	*Microcystis aeruginosa*	Liver damage
Nodularin	*Nodularia spumigena*	Liver damage
Saxitoxin	*Dolichospermum circinale* (formerly Anabaena circinalis)	No direct evidence of disease in humans from exposure in drinking water

More information - ADWG contains a factsheet - *Cyanobacteria and their toxins*

Queensland Drinking Water Regulatory Framework

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- Drinking water services are regulated in Queensland under the *Water Supply (Safety and Reliability) Act 2008* (the Act) and the *Public Health Act 2005*. This includes Regulations made under these Acts.
- Drinking water quality and safety is legislatively managed under a co-regulatory arrangement between the Department of Regional Development, Manufacturing and Water (DRDMW) and Queensland Health.
- Under this intra-governmental arrangement, DRDMW is the water supply regulator (the regulator) and Queensland Health, via its Water Quality Unit, implements and advises on the requirements of the *Public Health Act 2005* and Regulation.
- To help achieve this, registered drinking water service providers must have an approved Drinking Water Quality Management Plan (DWQMP) that is relevant to their current drinking water service(s) and documents how the safety of drinking water supplied to their customers is managed.
- Service providers must comply with their approved DWQMP including the conditions placed upon the plan as part of its approval. Section 93 of the Act provides it is an offence for service providers to not comply with their approved DWQMP or a condition of that plan.
- Conditions are placed on DWQMPs when the regulator approves the initial plan and the amended DWQMP. These conditions are provided in section 7 of the information notice for the decision issued to a service provider, when the DWQMP or amended DWQMP is approved by the regulator.

Queensland Drinking Water Regulatory Framework

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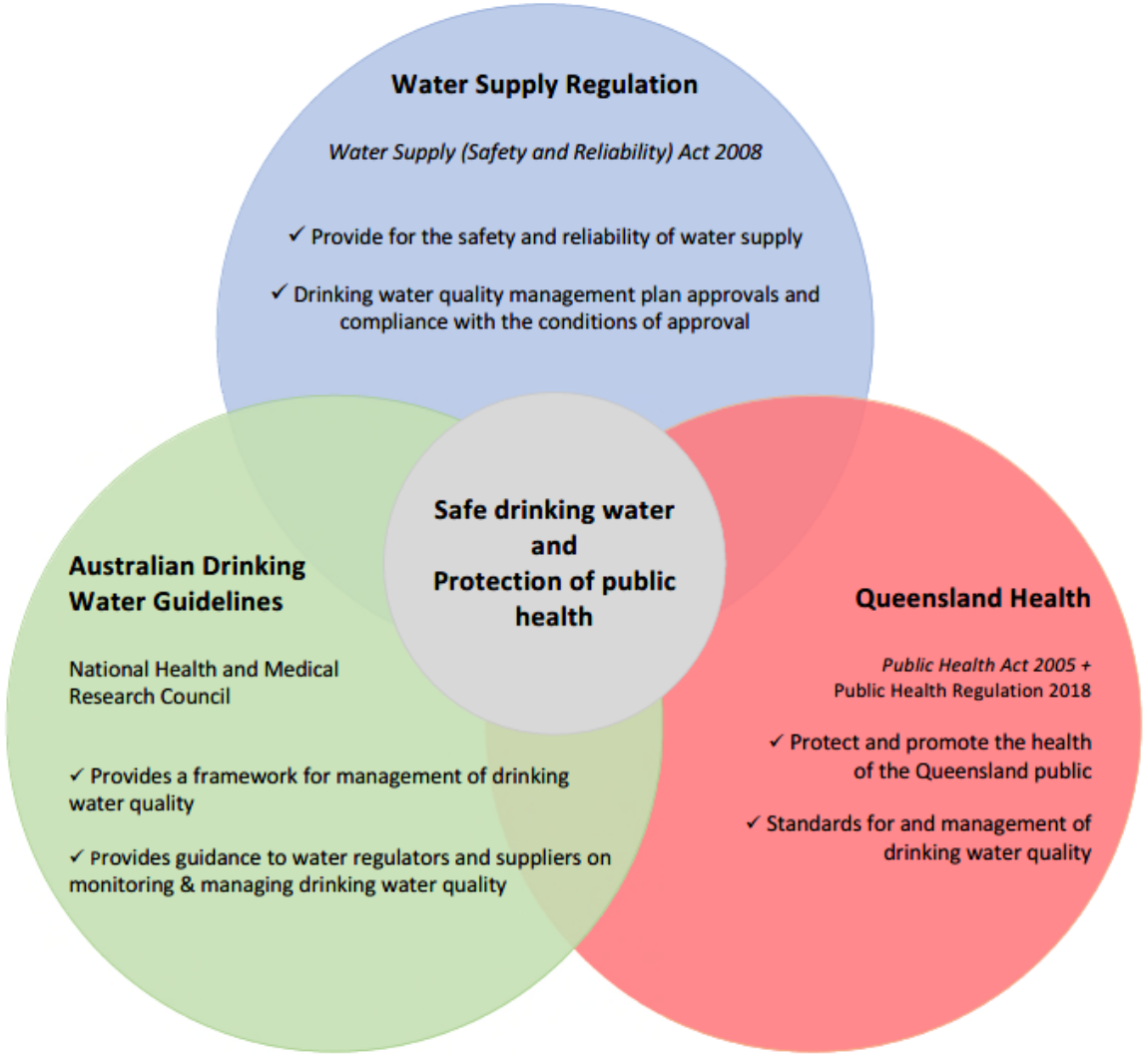
Figure 2: Relationship between state legislation and the ADWG



Queensland Drinking Water Regulatory Framework

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- Established under the *Water Supply (Safety and Reliability) Act 2008* (the Act).
- Aims to protect the public health and the interests of drinking water customers, through the delivery of safe drinking water.
- A drinking water quality management plan (DWQMP), approved by the regulator (Department of Regional Development, Manufacturing and Water), is the cornerstone of this regulatory framework.
- Subsection 95(3) of the Act prescribes a DWQMP, amongst other things, must:
  - ✓ be prepared in accordance with the guidelines, if any, made by the regulator about preparing the plan;
  - ✓ identify the hazards and hazardous events the drinking water service provider considers may affect the quality of water to which the services relate;
  - ✓ include an assessment of the risks posed by the hazards and hazardous events;
  - ✓ demonstrate how the drinking water service provider intends to manage the risks posed by the hazards and hazardous events; and
  - ✓ include details of the operational and verification monitoring programs under the plan, including the parameters to be used for indicating compliance with the plan and the water quality criteria for drinking water
- The regulator's published guideline is the *Guideline for the preparation, review and audit of drinking water quality management plans, Version 3, 1 October 2022.*

Guideline for the preparation, review and audit of drinking water quality management plans

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- This guideline contains best practice recommendations for safe drinking water supply in Queensland.
- This advice has been primarily derived from the Australian Drinking Water Guidelines (ADWG) (NHMRC 2011), as updated September 2022 and also references information/documents published Australian peak industry bodies (e.g., WaterRA, AWA, WIOA and WSAA) and advice from *qldwater* and Queensland Health.
- Service providers are required to prepare their DWQMPs (includes an amended DWQMP) in accordance with this guideline. The guideline refers to the matters that the Act requires must be included in a DWQMP and guidance on how to meet these requirements.
- The Act prevails to the extent of any inconsistency between the guideline and the Act or other legislation which applies to providers. The Act and other Queensland legislation can be accessed at www.legislation.qld.gov.au
- Subsection 95(3)(a) of the Act – A DWQMP must be prepared in accordance with the guidelines, if any, made by the regulator about preparing the plan.

Hazard identification

- Subsection 95(3)(d) of the Act – A DWQMP must identify the hazards and hazardous events the drinking water service provider considers may affect the quality of water to which the services relate.
- The DWQMP must identify the hazards and hazardous events the drinking water service provider considers may affect the quality of the water to which the services relate.
- The identification of hazards and hazardous events starts at the raw water source.
- Requires catchment characterisation and the collation and analysis of raw water quality data, including source water quality hazards, such as known and/or recurrent cyanobacteria growths in surface waterways and storages.
- Cyanobacteria growths require water and sunlight. Excessive cellular growth requires the addition of nutrients, notably phosphorus and nitrogen compounds, which are commonly found in fertilisers and sewage effluent.
- In rivers, shallow surface layers support growth, when the river flow decreases, causing stasis or inadequate mixing of the water column. In dams and other water storages, the surface layer depth promoting growth is also related to weather conditions and temperature variations, during day and night.
- Sunshine creates a surface layer of warm water and cyanobacteria bathed in sunlight in this warm layer can rapidly grow to excessive biovolumes.

Catchment Characterisation

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- The DWQMP must contain sufficient information about the characteristics for each source water's catchment area(s), including details of land use and likely contaminants from these activities for each drinking water scheme's catchment area, i.e., identify and describe all potential contaminant sources within the catchment areas.
- In connection with cyanobacteria, this includes:
  - ✓ surface water catchments and sub-catchments (streams, rivers, dams, other surface water storages);
  - ✓ climatic and seasonal variations, including rainfall events, cyclones, flooding, bushfires, drought, etc.;
  - ✓ rural and urban settlements;
  - ✓ human recreational activities;
  - ✓ agricultural, dairy and animal husbandry activities;
  - ✓ land clearing;
  - ✓ mining and chemical industries;
  - ✓ sewage treatment plants and septic tanks;
  - ✓ other planned or known future activities, which may adversely impact catchment water quality; and
  - ✓ historical contaminated sites (e.g., closed landfill sites).

Risk Assessment

- Subsection 95(3)(e) of the Act – include an assessment of the risks posed by the hazards and hazardous events.
- DWQMP must evaluate unmitigated, mitigated or residual risk levels and define uncertainties for the identified hazards and hazardous events, in each drinking water scheme.
- The risk assessment must determine the maximum unmitigated risk and residual risk with preventive measures in place.
- Where the risks are not under the direct control of the provider, the DWQMP must document how these risks will be managed. This includes consultation and communication protocols with the upstream provider or the owner of the source.

Manage the risks posed by the hazards and hazardous events

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- Subsection 95(3)(f) of the Act – demonstrate how the drinking water service provider intends to manage the risks posed by the hazards and hazardous events.
- DWQMP should include information about existing preventive measures and additional proposed preventive measures.
- Document the existing preventive measures for the hazardous events:
  - Source management (existing catchment programs, fences, planning and development policies, etc.), variant depth or changing the intake location, using an alternative sources, blending, desludging, animal or fish control, erosion control activities, Straw bales, aeration, etc.)
  - Treatment (cell removal: coagulation, settling and filtration, operator training, PAC, oxidation by chlorine, ozone, etc)
  - Treatment (toxins removal: oxidation by chlorine, ozone, RO, etc.)
  - Emergency measures for the control of blooms (specific chemical control, carting, public notification)
- For unacceptable risks further preventive measures need to be applied to reduce the risk (i.e., a strategy to address it in the short-term, medium-term and long-term actions in the RMIP)
- Data collection and research are important to improve the knowledge and certainty and prove the preventive measures are effective.

DWQMP operational and verification monitoring programs

- Subsection 95(3)(g) of the Act – include details of the operational and verification monitoring programs under the plan, including the parameters to be used for indicating compliance with the plan and the water quality criteria for drinking water
- There are many ways to measure the severity of HABs. Common metrics include cell count, toxin concentration and biovolume.
- The concentration of any toxins present in a sample can be measured. Note that relatively few laboratories conduct toxin testing and toxin testing can be more expensive than cell counting. Laboratories may opt to conduct toxin testing only when toxin producing cyanobacteria have been confirmed in sufficient numbers.
- Because cyanobacteria species vary widely in size, shape and toxicity, cell counts may not accurately reflect cell volume. To address this, biovolume can be used as a more accurate description of cell volume. Biovolumes are calculated based on cell count results and are reported by laboratories in mm^3/L.
- Advice on testing and the approximate turnaround time for sample analysis is available from Queensland Health Forensic and Scientific Services.
- Monitoring program should clarify the sample collection (procedure which describes the methods and training), describe the sample sites (consider safety issues), describe the parameters, be responsive (observation, increase /decrease frequency, implement testing of the treated water, etc.)

Incident and Event Management and Reporting

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- Section 102 of the Act and conditions placed on DWQMP, when the plan or amended DWQMP is approved.
- Conditions are stated in section 7 of the information notice for the decision, issued to the service provider pursuant to subsection 99(1)(b) of the Act, within 10 business days of the regulator approving the DWQMP.
- Terms applicable to incident and event reporting are also defined in section 7 of the information notice for the decision, including:
  - **'an incident'** is the detection of *Escherichia coli* (E.coli), an ADWG parameter or radioactivity that does not comply with the water quality criteria or a pathogen, i.e., a disease-causing microorganism (e.g., bacteria, viruses and protozoa).
  - **'an event'** is anything that has happened or is likely to imminently happen in your drinking water service, which you cannot manage under your approved DWQMP and/or which may adversely impact public health.
  - **'manage under your approved DWQMP'** means the hazard and/or a hazardous event is identified in the DWQMP and can be managed to an acceptable level of risk, i.e., the hazard and/or a hazardous event:
    - is identified in the risk assessment and has existing preventive measures documented in the DWQMP to achieve an acceptable risk level; and
    - has corrective actions documented in the DWQMP to comply with the water quality criteria, or below an 'interim' health guideline value, where applicable; or
    - can be managed by an operational procedure or as described in the DWQMP

Cyanobacteria Management Plan

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Service providers should prepare and implement a cyanobacteria management plan under their DWQMP.

As a minimum, this plan is to include:

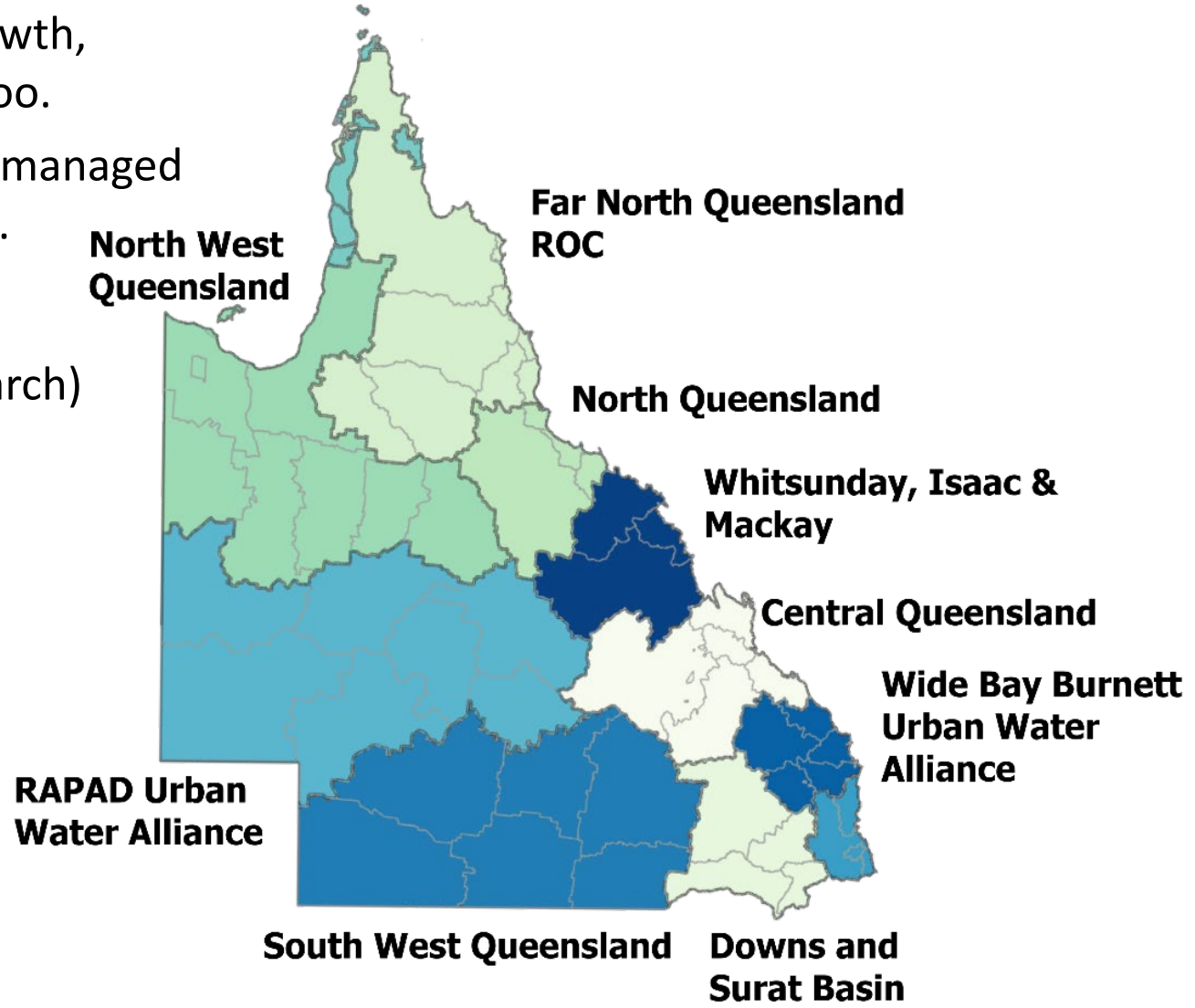
- the purpose of the cyanobacteria management plan;
- historical cyanobacteria growth;
- Water quality data/information;
- existing operational preventive measures and cyanobacteria bloom monitoring and management methodology;
- Sampling sites and monitoring methodology and frequency, including sampling parameter type (cell counts, biovolume, speciation, toxins) and ideally, laboratory(ies) used to conduct testing and analysis;
- Response protocols (action triggers, corrective actions and reporting) and recovery from cyanobacteria events, including identifying the measures required to minimise or prevent a recurrence;
- Any existing or planned research projects; and
- The cyanobacteria management plan's review methodology and frequency.

DWQMP Review and Amendment

- Section 106 of the Act and *Guideline for the preparation, review and audit of drinking water quality management plans, Version 3, 1 October 2022*.
- A service provider must regularly review the service provider's drinking water quality management plan, in accordance with the notice given to the service provider, by the regulator, under section 99 of the Act.
- The purpose of the review is to ensure the plan remains relevant having regard to the operation of the water service provided by the service provider.
- The DWQMP review process should include, amongst other things:
  - An analysis of all drinking water quality data obtained since the DWQMP was last reviewed, including its relationship to the historical water quality data held by the service provider;
  - Consideration of all incidents and events the service provider reported to the regulator, including the effectiveness of the preventive measures the provider implemented to control the incident or event, as well as the measures subsequently implemented to prevent a recurrence of the incident or event;
  - An evaluation of the efficacy of all preventive measures applied in the drinking water service operation; and
  - Updating all procedures and supporting documents implemented under the DWQMP, to ensure currency.

Queensland Water Regional Alliance Program (QWRAP)

- If you are experiencing excessive cyanobacterial growth, it is likely your neighbouring service providers are too.
- Cyanobacteria management strategies may be best managed on a regional basis, e.g., through the QWRAP group.
- DRDMW provides recurrent funding for QWRAP non-infrastructure Projects (process, systems, research)
- Many service providers have implemented BGA/ cyanobacteria management plans or procedures under their approved DWQMP.



Information Sources

Queensland Government

- NH&MRC *Australian Drinking Water Guidelines 6 2011*, *Version 3.8, Updated September 2022*
- WHO (World Health Organization) (1998). *Cyanobacterial Toxins: Microcystin-LR. Guidelines for Drinking Water Quality. 2nd Edition. Addendum to Volume 1. Recommendations*. World Health Organization, Geneva, pp 13-14.
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- Water Quality Unit, Health Protection Branch, Queensland Public Health and Scientific Services, Queensland Health
- Water Research Australia.
- Australian Water Association.
- Water Services Association of Australia.
- Water Industry Operators Association of Australia.
- CSIRO.
- Drikas M, Newcombe, G, Nicholson B (2002). *Water treatment options for cyanobacteria and their toxins. In: Blue-Green Algae: Their significance and management within water supplies*. CRC for Water Quality & Treatment Occasional Paper 4, pp 75-92.

Note: Cyanobacteria and cyanotoxin research is ongoing and we are learning more about these organisms every day