Unusual Presence of Cyanobacteria: A Sydney Experience

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The SCA is a New South Wales State Government (Australia) agency, created in 1999.

The SCA's main role is to manage and Sydney’s drinking water catchments to supply bulk water to its customers.

The SCA objectives include:
- managing and protecting the catchment and infrastructure
- managing the storages and storage infrastructure
- protecting public health and the environment
- ensuring that the supplied water is at appropriate quality
- operating along ecologically sustainable development principles
Presentation Outline / Scope

- SCA water network
- Lake Nepean – General background
- Lake Nepean cyanobacteria and inflows – 2011
- Lake Nepean cyanobacteria and inflows – 2012
- 2011 versus 2012
SCA Area of Operations

Blue Mountains

Warragamba

Prospect

Woronora

Upper Nepean

Shoalhaven
SCA Network

- Provides raw water for over 4 million people

Lake Nepean
- Local water supply (~25K)
- Water transfer – Sydney
- Water transfer – Illawarra
Lake Nepean: Nepean and Bourke Rivers

- Height: 82 metres
- Length: 216 metres
- Capacity: 70,000 ML
- Catchment: 320 sq. km
- Lake: 3.3 sq. km

- Nepean R: agricultural and forested
- Bourke R: Forested
- Artificially destratified
- Variable off-take
Water level increased significantly in March

Water quality near the dam wall
- TN – reasonably stable
- TP and FP – reasonably stable
- Microcystis aeruginosa...?

A minor incident
Distribution in the Lake - 2011

0.5, 2.5 and 5 km from the dam

Diurnal variation
Rise and Fall of cyanobacteria - 2011

Depth.....?
Toxin production capacity - 2011

Microcystin-LR eq (µg/L)

Mar-11
Apr-11
May-11
Jun-11
Jul-11
Aug-11
Typical cell quota
Toxin LOR

DNE2: 0 - 6 m
DNE2: 15 - 20 m
DNE2: 25 - 30 m
DNE2: 35 - 40 m
DNE3: 0 - 6 m
DNE5: 0 - 6 m
DNE5: 15 - 20 m
DNE5: 25 - 30 m

HPLC analysis?
Nepean Cyanobacteria - 2011

Summary

• Inflows brought nutrients, but the concentrations were not exceptional
• *Microcystis aeruginosa* cells were detected in May
• The unusual growth dominated in June and July, the cooler months
• *Microcystis aeruginosa* population almost reached 6500 cells/mL
• Toxins did not exceed 1.3 µg/L of microcystin-LR toxicity equivalent
• Cell population and toxins were reasonably consistent up to 5 km
• Cell population and toxins were significant up to 35 – 40 m deep
• *Microcystis aeruginosa* produced toxins at the theoretical quota
• Microcystin-LR was the dominant strain among the toxins

But, why.....?
Nepean Cyanobacteria – 2012 and 2011

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2011</th>
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<tbody>
<tr>
<td>Month</td>
<td>Feb - Mar</td>
<td>Mar - Apr</td>
</tr>
<tr>
<td>Peak total daily flow (ML/D)</td>
<td>13,000</td>
<td>4,600</td>
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<tr>
<td>Water column condition</td>
<td>Destratified</td>
<td>Destratified</td>
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<tr>
<td>Inflow (arrival)</td>
<td>Underflow</td>
<td>Underflow</td>
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<td>Water column (before the inflow )</td>
<td>Intermittently mixed</td>
<td>Mixed</td>
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<tr>
<td>TN (mg/L) in 0 – 9 m</td>
<td>0.32 – 0.45 (up to 0.52)</td>
<td>0.3 – 0.36 (up to 0.50)</td>
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<tr>
<td>TP (mg/L) in 0 – 9 m</td>
<td>0.010 – 0.03</td>
<td>0.012 – 0.017 (up to 0.02)</td>
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</table>
Total nitrogen – 2012 and 2011

- 0 - 9 m
- 10 - 34 m
- 35 - 60 m
Oxidised nitrogen – 2012 and 2011

Graph showing the concentration of oxidised nitrogen (mg/L) over time from February 1, 2012, to May 24, 2011. The graph compares data from different depth intervals: 0 - 9 m, 10 - 34 m, and 35 - 60 m.
Total phosphorus – 2012 and 2011

- 0 - 9 m
- 10 - 34 m
- 35 - 60 m
Microcystis – 2011 and 2012

- Microcystis aeruginosa
- Aphanocapsa sp.
- Aphanathece sp
- Cyanodictyon sp
- Cyanonephron sp
- Microcystin toxin

Cyanobacteria (cells/mL)


Microcystin-LR equivalent (µg/L)
Nepean Cyanobacteria – 2011 and 2012

Summary

• Inflows brought more water and more nutrients in 2012
• *Microcystis aeruginosa* was reported at lower populations in 2012
• *Microcystis aeruginosa* did not persist in 2012
• Toxin concentration somewhat similar in 2011 and 2012, but the peak concentration was very high high in 2012
• Unlike consistent *Microcystis aeruginosa* detections in the water column in 2011, growth was confined to the surface in 2012
• *Microcystis aeruginosa* produced toxins at well above the theoretical quota in 2012
Nepean inflows and mixing – 2012 and 2011

Mixer status

- Nepean River Inflow
- Bourke River Inflow
- Glenquarry Cut Release

Flow (GL/d)