Lake Hume Integrated Water Quality Study
Summer and Autumn 2006–07

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EXEcutivE Summary

The objectives of the study were to:
1. Identify drivers of water quality (including blue-green algae) in Lake Hume during periods of low storage levels
2. Identify downstream impacts of poor water quality releases from Lake Hume
3. Assess the impact of Dartmouth LLOW releases on Lake Hume water quality during low storage levels
4. Identify rehabilitation options in the Lake Hume catchment and determine their potential benefits
5. Evaluate management options for the improvement of water quality in Lake Hume during periods of low storage levels.

Outcomes

Significant blue-green algal biovolume was present during the drawdown. Blue-Green algal dynamics in Lake Hume during periods of extreme drawdown would appear to be driven by a combination of hydrodynamics and temperature within the lake. This study showed that the Murray River arm of the reservoir is a ‘hot spot’ for nutrient production. Stratification and subsequent anoxic conditions promote the release of nutrients – ammonium, organic nitrogen and total phosphorus – from the sediments into the overlying hypolimnion. Because the depth of the lake is relatively shallow, wind driven events can lead to a substantial deepening (turnover) of the thermocline allowing periodic pulses of nutrients into the warm surface layer. These nutrient pulses then stimulate algal growth. Warm inflows from the Murray River served to push the blooms formed at Bethanga towards the main basin of the lake.

Lake Hume changed the algal community structure in the Murray River. Upstream of the reservoir green algae were the most dominant species; within and downstream of the reservoir cyanobacteria dominated. Much of the algal biomass found at the downstream sites appeared to originate in Lake Hume and was physically transported downstream. Lake Hume was net exporter of carbon, nitrogen, phosphorus and iron and was a net sink for manganese. Most of the carbon, nitrogen and phosphorus exported from the lake was probably in algal biomass.

The low-level releases of water from Dartmouth Dam had effects on water quality in Lake Hume and the Mitta Mitta river. The largest effect was decline in water temperature which has significant impacts on nutrient and algal dynamics in Lake Hume. Smaller effects were also observed for other water quality parameters, but overall with the exception of nitrate, low-level releases from Dartmouth Dam had little influence on water quality entering Lake Hume. Macro-invertebrate community structure was not affected by low-level releases.

Sedimentation rates in the main basin of Lake Hume are quite low, particularly in the Mitta Mitta Arm of the lake. There was no apparent change in the source of the sediments in the Murray River arm since the dam was commissioned. Sediment does not appear to be sourced from bank erosion in the Murray River Catchment. Levels of arsenic, chromium and nickel in some sediment samples are higher than the Australian Interim Sediment Quality Guidelines low trigger level, and therefore of some concern.

Significant quantities of carbon, nitrogen and phosphorus become bound up in terrestrial vegetation that have colonised the bed of Lake Hume during extreme drawdown. Phosphorus uptake from the sediment into plant material may represent a significant pathway for phosphorus re-mobilisation in Lake Hume.
7. Current sediment delivery rates to Lake Hume aren’t of concern in terms of loss of storage capacity, at least in the next several decades. A long-term management strategy should be to ensure that sediment delivery rates do not increase (i.e. developments in the upper catchment that could lead to increased sediment loads should not be permitted). An aerial survey to identify potential sources of gully erosion is recommended. The lake’s sediment is a significant store of contaminants which in turn may impact on water quality. Elevated levels of arsenic, nickel and chromium may pose a long-term threat to water quality in the lake. Past mining activity in the Bethanga-Talgarno area as a source of arsenic and nickel to the lake sediments needs to be confirmed, hot spots identified and remedial actions (including minimising sediment runoff) should be undertaken. Furthermore, the potential for remobilisation of arsenic and chromium from the sediments should be assessed.

8. Grazing is a potential solution to reducing the impact of vegetation on water quality on refill of the reservoir after extreme drawdown. However, there are a number of important considerations. Firstly, the dominant plant species colonising the lake bed are, for the most part, not suitable as cattle fodder and have the potential to be toxic. There is also some evidence of bioaccumulation of some heavy metals to levels that can impact on the marketability of beef cattle that have grazed on the lake bed. While grazing can reduce overall plant biomass, because of recycling, it would be less successful in removing nitrogen and phosphorus from the lake bed. The risk of livestock zoonotic parasites to public health remains unknown and needs to be addressed.

Management Considerations

1. The risk of the occurrence of blue-green algae in Lake Hume increases as the water depth over the period December-April decreases and as a result increased monitoring for cyanobacteria should be implemented during periods of drawdown.

2. The MDBC should consider permanently deploying a suite of sensors in Lake Hume to gain further insights into the drivers of water quality in the reservoir and investigate the use of new techniques to enumerate cyanobacteria.

3. If possible partial refilling of the reservoir during summer drawdown should be avoided.

4. As inflows from the Murray River influence the distribution of algae in the reservoir, the potential for modifying the magnitude and timing of inflows from the Murray River during periods of blue-green algal blooms in Lake Hume should be explored. In particular the inflow pulses need to be factored into any storage operation rules during low dam levels (less than about 10–15% of full capacity).

5. The lake modifies water quality in the Murray River, particularly in converting inorganic nutrients into algal biomass that is exported downstream. The full extent of the influence of Lake Hume on algal dynamics has yet to be determined, but its influence can be detected as far downstream as Corowa.

6. If cyanobacterial blooms appear in the lake, there is a very strong likelihood that cyanobacteria will be transported downstream at levels that pose a risk to public health. Therefore, it is recommended that regular monitoring of cyanobacterial populations be undertaken at a number of sites within Lake Hume at least during the period of November to May. This is of particular importance if low water levels in the reservoir are predicted.

7. Current sediment delivery rates to Lake Hume aren’t of concern in terms of loss of storage capacity, at least in the next several decades. A long-term management strategy should be to ensure that sediment delivery rates do not increase (i.e. developments in the upper catchment that could lead to increased sediment loads should not be permitted). An aerial survey to identify potential sources of gully erosion is recommended. The lake’s sediment is a significant store of contaminants which in turn may impact on water quality. Elevated levels of arsenic, nickel and chromium may pose a long-term threat to water quality in the lake. Past mining activity in the Bethanga-Talgarno area as a source of arsenic and nickel to the lake sediments needs to be confirmed, hot spots identified and remedial actions (including minimising sediment runoff) should be undertaken. Furthermore, the potential for remobilisation of arsenic and chromium from the sediments should be assessed.

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References


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Cover Photograph: Lake Hume (photo by Helen Gigney)

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