Part 2 - Sampling Program to Address Critical Knowledge Gaps in Lake Mulwala

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September 2004
1 Identified Knowledge Gaps

Following a review of existing studies on Lake Mulwala and its catchment (Howitt et al. 2004) five key knowledge gaps were identified:

1.1 Sediments
The importance of sediments as a sink for a range of substances including nutrients, hydrocarbons, pesticides and heavy metals has been highlighted. This means that the sediments are not only an important source of contaminants to the water column, or sink of contaminants from the water column (depending on the conditions at the time) they also potentially provide a method of assessing the history of inputs to the lake. Analysis of sediment samples is important to determine if heavy metals and pesticides (which have been poorly characterised in the water column by existing monitoring programs) have been imported into the lake over time, and whether they may have accumulated to concentrations that may be of concern. In addition sampling sediment at increasing distances from stormwater outputs could assist with the determination of the impact of stormwater on the lake and the types of contaminants that are being introduced to the lake from runoff. This would be an important tool when the management of stormwater from Mulwala and Yarrawonga is being planned.

1.2 Stratification
It is particularly important to consider the possibility of stratification within Lake Mulwala when dealing with the issue of nutrient inputs to the lake. The biogeochemistry of sediments is quite different under anoxic conditions and, has the potential to turn the sediments from a sink for nutrients and metals to a source of metals and nutrients (particularly phosphorus). In addition, changes to nutrient cycling under anoxic conditions can potentially result in the production of chemical species like ammonia and hydrogen sulphide that are toxic to aquatic organisms such as fish and mussels. It has generally been assumed that Lake
Mulwala is not subject to stratification, even in the summer period, as a result of its shallow depth and rapid turnover of water. However, the presence of soluble manganese (Samblebe 2003) suggests that at least part of the lake has very low oxygen at some times. It is possible that under low flows, with little wind and high organic loadings or, during periods of high temperature, that parts of the lake become stratified and potentially oxygen depleted. It is important that the question of stratification and oxygen depletion is addressed so that all potential sources of nutrients and metals to the lake are considered in management plans.

1.3 Blue-Green Algae

It is clear that blue-green algae is an important issue for the management of Lake Mulwala, especially as blooms not only interfere with the supply of drinking water to local and downstream residents, but are also likely to coincide with peak times for recreational use of the lake (as happened this summer) and have the potential to impact on the tourist industry if the lake is closed to recreational users during the summer months. An important step in dealing with the blue-green algae problem is to reconcile the differences in the various monitoring programs so that it can be determined if the increasing trends are real or the result of changes to sampling or analytical techniques.

1.4 Vegetation Mapping

The existing studies of vegetation in Lake Mulwala have provided only a snapshot of the vegetation communities over a very short period of time. Management of the vegetation in and around the lake requires ongoing monitoring so that annual or long-term community changes can be observed. Processes threatening riparian and aquatic vegetation and known to occur in the area surrounding Lake Mulwala include saline groundwater intrusion, introduction of weedy and invasive species and increased nutrient loading and turbidity. Given the potential threats and the lack of baseline data on vegetation at this site, it is important to establish a monitoring program to assess any impacts of
these threats over the coming years and also assist in future natural resource management planning for Lake Mulwala.

1.5 Loads

It is not possible to calculate accurate load estimates for most chemical parameters relevant to the lake from past water quality studies due to the low frequency of sampling. Weekly or monthly data is simply of insufficient resolution for accurate load assessments to be made, as nutrient concentrations in the water can vary substantially over a period of days, or even hours.

2 Proposed Sampling Program

2.1 Sediments

Objectives –

- To determine the distribution of heavy metals, pesticides and hydrocarbons in sediments in Lake Mulwala.
- To determine if shore based activities, particularly storm water drains and fuelling facilities effects adjacent sediment quality.
- To determine whether or not sediment concentrations of contaminants exceed ANZEEC (2000) sediment quality trigger levels.

Methods –

Using a stratified random-sampling design, 50 surficial sediment samples from across the lake will be taken using an Eckman grab. Particle size analysis will be determined using the ‘hydrometer’ method of Grimshaw (1989). Carbon content will be estimated by loss on ignition at 550 °C. Metals (Cu, Pb, Cd, Zn, As, Se, Fe, Mn, Ag, Cr, Ni, Al and Hg), organo-chlorine pesticides, organo-phosphate pesticides, PCB’s and Total Petroleum Hydrocarbons will be determined by an external NATA-accredited Laboratory.
Anticipated Outcomes –
This study should indicate whether or not the effects of shore based activities have had a long-term impact on the sediments of Lake Mulwala. Furthermore, the sediment data will provide baseline data (of known and documented quality) to compare future sediment quality studies against.

2.2 Stratification
Objective –
- To determine whether there is any evidence that thermal stratification occurs in Lake Mulwala during Summer.

Methods –
A calibrated thermistor chain, with temperature probes placed at approximately 1 metre intervals, will be deployed in the deepest part of the Lake for a period of about 6 weeks over summer to determine if sustained temperature differentials exist between surface and bottom waters. In addition, dissolved oxygen depth-profiles will be determined on one occasion (in mid-summer) at approximately 50 sites across the whole of the lake to see if anoxic zones are present.

Anticipated Outcomes –
This study will provide an understanding of the thermal and oxygen profiles of the Lake that can be used to inform the design of any subsequent water-quality monitoring program; in particular, whether or not only taking surface water samples is adequate to reflect the water quality in the lake.

2.3 Algal Distribution
Objective –
- To determine the spatial distribution of algae in Lake Mulwala during an algal bloom.
Methods –
25 surface and 3-metre depth-integrated samples will be taken across the Lake during a medium- or high- blue-green algal alert using the methods described in Hötzel and Croome (1999). Samples will be preserved in Lugol’s solution and returned to the laboratory for subsequent identification and counting.

Anticipated Outcome –
This study will provide the background necessary to design a rational algal-sampling program for Lake Mulwala.

2.4 Vegetation

Objectives:-
• Design a long-term monitoring program of the vegetation of Lake Mulwala which characterises the vegetation community and quantifies changes in distribution, abundance and condition of vegetation over time,
• Conduct the initial, baseline assessment utilising the sampling program developed.

Methods:-
A monitoring program will be developed using the methodology described in (Baldwin et al. 2005). The program will be at the wetland scale and be designed for repeat assessment on an annual or biennial basis. The objectives of the program will be to characterise the riparian and aquatic vegetation communities of Lake Mulwala, including assessing abundance, distribution and condition. Vegetation abundance and distribution, incorporating assessments of regeneration, are mainstays of vegetation monitoring, and are particularly useful for monitoring changes to populations of weed species. Assessments of condition relate to the vegetation’s overall “health” as well as its capacity to perform ecosystem functions such as nutrient and water cycling, which are relevant to the threatening processes occurring in the region. Methods will
include a combination of on-ground point, quadrat and transect techniques. Field work will be conducted in summer of 2004/2005, with the intent that future sampling be performed in summer on an annual basis. Datasets derived from the assessment will be collated into an electronic database for ease of incorporation of future monitoring data, enabling analysis of changes to vegetation over time.

Anticipated Outcomes:
- A standardised sampling program for monitoring changes to the riparian and aquatic vegetation communities of Lake Mulwala over time, including protocols, equipment lists and field data sheets.
- A baseline data set characterising the vegetation communities of Lake Mulwala.

2.5 Loads
At this stage we do not intend to undertake a detailed study into the loads of nutrients or other compounds entering and leaving the Lake. However, if required we can provide details on the design of such a program.

3 Costs
Although the new schedule of works will be slightly more expensive than anticipated in the contract, it is not sufficiently different to warrant a change to the pricing schedule.

4 References


