

An Adaptive Management Framework in Coastal Waterways: A Case Study in Currimundi Lake, Queensland

Peta Williams and Rodger Tomlinson

Griffith Centre for Coastal Management, Gold Coast Campus, Griffith University, Qld
4222

ABSTRACT

An Adaptive Management Framework (AMF) is a systematic process for continually improving management policies and practices by learning from the outcomes of operations through research.

There are many benefits to an adaptive management framework as it allows for decision making to proceed even when there are considerable gaps in knowledge and uncertainty, by specifying actions, monitoring and adjustment of visions, targets and associated management practices.

This paper will look at the specific example of Currimundi Lake where an adaptive management framework will be integrated with the existing monitoring program, therefore, not requiring the development of sophisticated water quality and sediment transport models. This allows Council to save on costs as the plan is easily adapted with less expertise and future research required. Currimundi Lake, situated on the Sunshine Coast, has been an issue of growing concern to the community. These concerns have primarily focused on biting midge problems, water quality, entrance management and bank erosion. There is also concern over the impact of the connection of the artificial Lake Kawana into Currimundi. Before appropriate management strategies could be adopted for the lake, it was important to understand the dynamics of the lake and the changes that have occurred over time.

A plan for integrating monitoring data, modelling and management action has been developed and implemented. The plan sets out the procedures for interfacing these components and to develop the AMF. Regular support for the AMF is to be provided with an on-going review of the implementation process, evaluation of the system components including the verification of model outputs and calibration of the monitoring system. An AMF in this context provides a cost effective way of maximising the long term capacity of Council to improve the overall management of a coastal waterway.

INTRODUCTION

An Adaptive Management Framework (AMF) is a systematic process for continually improving management policies and practices by learning from the outcomes of operations through research. Adaptive management is a concept and process that has been widely promoted for many years as a way for managing complex issues. More recently the Australian Government has promoted adaptive management as part of the programs for achieving regional natural resource management (NRM) (CRC, 2006).

There are many benefits to an adaptive management framework as it allows for decision making to proceed even when there are considerable gaps in knowledge and uncertainty, by specifying actions, monitoring and adjustment of visions, targets and associated management practices.

The CRC (2006) state that the AMF includes six basic components:

1. **Information collation:** Where information from stakeholders and ongoing research is pooled and organised so it can be readily accessed and used to improve common understanding of NRM issues and opportunities.
2. **Systems analysis and vision:** Where stakeholders come together to develop their NRM vision and aspirations for a particular location, catchment or region and develop a systems approach to their assets to enable differing perspectives, values and beliefs and linkages between understandings to be explored. Concepts are refined to provide a workable understanding of the ecological system and its expected responses.
3. **Plan making:** Where stakeholders collectively establish NRM goals and targets and negotiate a preferred strategy based on consideration of multiple and sometimes conflicting objectives and possible trade-offs that may be required.
4. **Implementing actions:** Where stakeholders assign roles, responsibilities and resources to conduct the agreed actions for achieving goals and targets in the plan.
5. **Monitoring and reviewing:** Where stakeholders evaluate progress towards the vision, goals and implementation schedule and targets established at the start of the adaptive management process, and modify goals or practices as a result of emerging knowledge, using agreed review timelines.
6. **Core components:** Comprise the facilitation and management of the adaptive management process and the evolving knowledge where networking, learning, negotiation, conflict resolution and knowledge development processes are organised.

CURRIMUNDI LAKE DYNAMICS STUDY

Currimundi Lake is a coastal lagoon which is intermittently open to the ocean. Development in the catchment has seen the construction of three canals in the 1980s and 1990s which now form part of the tidal waterways of the Lake. The lake has also recently been connected to the artificial Lake Kawana via a weir. Currimundi is located in Caloundra (Figure 1) within the Sunshine Coast Regional Council.

In recent years, there has been growing community concern over the state of Currimundi Lake, and the condition of the entrance. These concerns have primarily focused on biting midge problems, water quality, entrance management and bank erosion. Before appropriate management strategies can be adopted for the lake, it is important to understand the dynamics of the lake and the changes that have occurred over time.

Historically, Currimundi has been functioning as an Intermittently Open and Closed Lake and Lagoon (ICOLL). In its natural state an ICOLL will generally be closed to the ocean during periods of low freshwater input or high sediment movement on the beach. The ICOLL will open in response to elevation of the lake water level due to flooding or a major storm erosion event. The ICOLL ecosystem establishes a natural rhythm of intermittent flushing and quasi-still water conditions.



Figure 1. Location of Currimundi Lake (Source: Google Earth, 2009)

Prior to the 1950s, Currimundi was in a relatively natural state by all accounts, and would have on average been semi-closed with a low flow tidal channel connecting the lake to the ocean through a wide sand berm. Under these circumstances, the water level would be stable and vegetation and aquatic fauna would have been established to suit these conditions. The occasional breakthrough and flushing of the lake would have disrupted these conditions for a short time, but the semi-closed state would have re-established rapidly.

There have been four categories of activity which summarise the changes that have influenced Currimundi in recent years.

- The political decision in the 1960s to legislate that the entrance be kept open. From the data available this decision has been interpreted more in that there should be always tidal flow between the lake and the ocean, rather than there being a full tidal exchange with the ocean. Subsequent development in the Kawana estates has assumed that the entrance will be kept open for flood minimisation.
- In 1980 the lake system was extended to include the Pangali and Barooka Canals and then in 1994 the Tokara Canal was completed. This was associated with the start of rapid increase in population with associated stormwater runoff and water quality issues.
- In the early 2000s the influence of the Lake Kawana development began to be felt with the temporary weir being installed which in effect connected Currimundi to Lake Kawana during spring tides. In 2006 the permanent weir was completed. In addition to the increase in tidal flow via this weir there is also a flow discharge coming indirectly from the Mooloolah River to ensure adequate flushing of Lake Kawana.
- Finally, in 2003, after pressures from the community, a major dredging activity saw the removal of much of the sand plug at the entrance. This was the first time dredging of this magnitude had been carried out.

All of these events will be acting to change the preferred state of dynamic equilibrium and hence their impact must be understood before management strategies are developed for the future.

The Caloundra City Council Lake and Estuary Risk and Operational Management Protocol (LEROMP) document prepared by Council Officers provides both an excellent overview of the issues and also a risk management framework for action. In most regards these issues are inter-related. A summary of these issues is included below.

Biting Midge

Midges are an increasing community problem in the Lake area and mitigation options are being investigated with the aim to achieve a balance between public health and wellbeing and the environment as a whole.

Entrance Dynamics

Understanding the entrance dynamics is important for the future management of the system as a whole.

Bank Erosion

Increasing bank erosion is of concern not only due to the loss of bank vegetation and parkland but also due to the introduction of sediment into the system.

Ecosystem Health

Council and community groups have routinely collected water quality data for some years. An analysis of the data to determine relationships between environmental factors, entrance regimes and other changes to the lake configuration and the occurrence of water quality deterioration has been completed as part of the proposal to Council.

In order to develop effective management actions for Lake Currimundi it is important to recognise that all the current issues of concern are inter-related. The study will establish a framework for an adaptive management approach to lake management and sets out an implementation plan. The implementation plan is flexible and can be effective initially and can then be developed into a more sophisticated system.

A few of the tasks that have been undertaken include:

1. Analysis of existing water quality data.
2. Long-term Monitoring system including flow, water levels, entrance size and position.
3. Community engagement program.
4. Currimundi waterways model –Examining tidal and in-bank stormwater flows.

RESULTS

Recommendations, as part of the AMP submitted to Council will cover the four issues of concern in Currimundi Lake. Two examples of these results are included below.

Midges

Currimundi Lake is a unique system and the fact that Council is able to close the lake and vary the water levels presents a unique opportunity to achieve effective biting midge control that does not rely on chemical spraying or other techniques that pose a far higher risk to the environment. By closing the lake the larval and pupal midge are drowned or eaten by fish and other predators. The lake has to be closed at least 4 weeks to cover the later half of the midge breeding cycle. Extending the closure

beyond 4 weeks can significantly increase the impact on midge abundance. Reducing the midge populations early in the breeding season should have an impact for several months at least (Figure 2) (Butterworth, 2005).

The environmental impact of closing the lake is likely to be negligible as the system naturally closed for much longer periods in the past. Council monitors a range of parameters (e.g. water quality) during and immediately after the closure to assess the overall impact on the system.

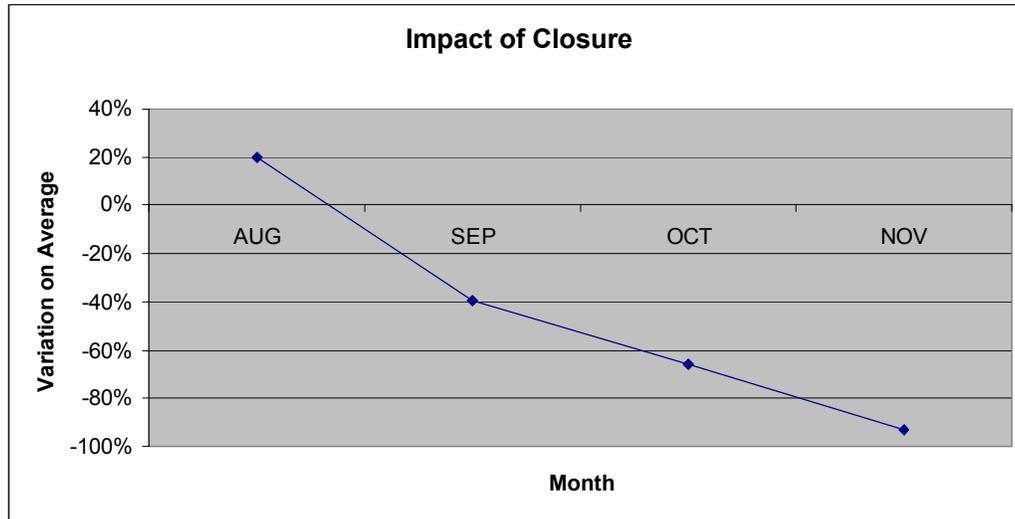


Figure 2. Reduction of midge after October 2007 closure (Source: Butterworth)

Water Quality

In general the nature of water quality within Currimundi Lake was good. Since 2001, temperature, salinity and pH measurements were generally within the EPA guideline levels, but did not fall within the water quality objectives specified for Caloundra City Council. Faecal coliforms were generally within the guidelines for secondary exposure, but many observations were significantly higher after significant rainfall events such as storms. The system appeared to be enriched with nitrogen: almost all ammonia, oxidized-N and total-N measurements were above the guideline values at most times. The total phosphorus and orthophosphate concentrations were within the guidelines most of the time. Dissolved oxygen concentrations are consistently lower than guideline values at all sites. Overall, there does not appear to be any temporal trend for any of the water quality indicators (USC, 2008).

Data collected from before and after January 2005 showed that water quality indicators generally improved since the Currimundi mouth was opened and pumping from Lake Kawana commenced. In particular, dissolved oxygen concentrations have increased and nutrient concentrations have decreased. Despite the improvement since January 2005, several water quality indicators continue to regularly exceed the water quality guidelines. The role of external drivers (e.g. significant rainfall events) is likely to be an important factor in determining water quality of the system and how often guideline values are breached (USC, 2008).

Recommendations to the community groups and Council have been made to continue their monitoring program with the possibility of Council including the additional monitoring of chlorophyll-a.

CONCLUSIONS

In order to develop effective management actions for Lake Currimundi it is important to recognise that all of the current issues of concern are inter-related. Management of existing and future catchment developments should focus on minimising their negative impacts on the whole lake system.

It should also be acknowledged that there appears to be a fundamental shift in the dynamics of the lake from that of a traditionally mostly-closed ICOLL to characteristics more representative of a low-freshwater input estuary. Under these circumstances a shift in the dynamic-equilibrium state of the lake ecosystem may also be occurring and the entrance may behave differently from the past. Further, it should be acknowledged that the condition of the lake varies significantly depending on ambient conditions and imposed management actions.

The proposal put forward to Sunshine Coast Regional Council is a management action plan based on best practice at the time. This practise can then be taken and the response of the system monitored and models re-calibrated, thereby improving future outcomes in an adaptive management framework. This approach integrates with the Council's existing monitoring program and does not require the development of a sophisticated water quality and sediment transport model, but does however require a long term commitment to maintain the monitoring program and the use of simpler computational models.

TAKE HOME MESSAGE

An AMF in the context of the Currimundi Lake Dynamics Project provides a cost effective way of maximising the long term capacity of the Council to improve the overall management of its coastal waterway.

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