City of
Wagga Wagga

Lake Albert Management Plan 2009 – 2015

Adopted February 2010

TABLE OF CONTENTS

ATTACHMENTS

EXECUTIVE SUMMARY

Lake Albert has existed as a recreation lake for the Wagga Wagga community for in excess of 100 years, although it has changed a little in nature, during that time. Unfortunately in looking forward, it needs to be recognised that if the Lake is to continue as a recreational lake, the Community must address three distinctive and opposing threats that the Lake is currently facing. These are:

1.0 An acute lack of rainfall (particularly in the period 2001 -2009), which has resulted in very limited inflow from the rural catchment during this period, and this is arguably the threat most perceived by and topical with the community at the time of preparing this management plan.

Experience (reinforced by studies) confirms that the rural catchment is the critical filling mechanism for the Lake. Therefore with the absence of any significant inflow from the catchment, evaporation has again been able to render the stored water in the Lake unsuitable for boating type activities in a relatively short period of time. This has denied the use of the Lake for boating type activities.

This is a short term loss of some recreation capability that historical data indicates generally occurs once around every 20 years, but in this instance it has occurred twice through this 2001 -2009 period. It would also appear that the Lake when under extreme evaporation is reverting back to the "Swampy Plain" scenario that existed before the Lake was created, and hence there is some hope that at least a base body of water will be retained for some time, for other users of the Lake for some time prior to the creation of this management plan.

2 Accumulation of sediment that occurs when the Lake is filling. There is around 1,000,000 m^3 of such sediment that has been accumulated in the Lake over time (but predominantly since the mid 1970's). Unchecked this sediment accumulation has the potential to render the Lake permanently unavailable for boating activities. Indeed a strong case could be made that if nothing is done that these recreational boating activities will become either severely limited, or non-existent by as soon as 2030.

3 Climate Change as the full impacts of this phenomenon on the Lake into the future are not well understood at this time.

Given these threats, and the high community usage of the Lake, then a series of decisions will need to be made in relation to the Lake's future. Clearly these decisions will commence with determining the long term directions for the Lake, and once those decisions are made, the next series of decisions will filter down to actions that need to be done, to support the directions adopted. In the longer term the community will essentially need to choose between:

- If the Lake should be retained as a perpetual recreational water body, including all of the same functions it currently has, irrespective of the costs involved?

- If the Lake should just be allowed to become a natural waterway in due course, with the community taking advantage of any recreational activity until that date comes?
- Some other alternative that may be potentially reached, in between these distinct positions?

Simplistic solutions, such as removing the accumulated sediment and finding alternative top up mechanisms, appear to be cost prohibitive, generally being in excess of $20 Million each for those options most likely to be successful. Clearly a more complex solution will need to be found.

Before asking the Community to make any such decision, there is however a number of key tasks/ studies that need to be undertaken during the life of this Management Plan, to provide the background information required for that decision making. Thus the purpose of this Management Plan effectively becomes to arm the Community and Council with the data they require in relation to Lake Albert, as well as identifying what must be done to gather that data required for the decision making process. The Plan also suggests that the historical disparate management of the Lake by a range of NSW Government Agencies and Council should cease, and be replaced with a closer working partnership between Council and these agencies to guide future development and management of the Lake.

Most importantly, this Management Plan recommends that until those final decisions are made that the common goal that all parties should be working towards, is retaining the Lake as a recreational water body till at least 2050. This goal is achievable, without significant cost impost to the community, and provides the Community with the time required to make well considered decisions (on the longer term directions for the lake) without these actions themselves prejudicing those decisions. However it must be stressed that this interim goal still requires that some targets be set within this Management Plan, to at least ensure all of the Lake's management bodies are moving in the same direction. The suggested targets are set out below.

- Reduce the average annual accumulation of sediment flowing into the Lake to a maximum of 10,000 m^3, which will halve the current rate of accumulation of sediment and give the Lake another 20-30 years of life as a recreational lake. If some sediment can economically be removed in addition to the reduced accumulation rates, then this also adds to this life extension of the recreational lake.
- Increase stormwater runoff into the Lake by 50% over current inflows as a minimum gain and look at just what is possible through stormwater harvesting. Stormwater was viewed at the time of preparing this Management Plan, as the most cost effective top up option, and it was also appeared to be the community preferred top up alternative, in a recent Council survey.
- Make the Tatton Drain diversion safer for the users of Lake Albert Road and the downstream community.
- Gain a better understanding of exactly what is happening in the Lake's catchment, and then develop subsequent plans to try and maximise the outflow of water from the catchment, to the Lake, under all rainfall conditions.

- Develop a better understanding of the performance of the Lake under different rainfall and evaporation conditions, by providing much more detailed analysis, through day to day monitoring of the Lake's top water levels.
- Look to find dynamic ways to expand the full potential offered to the Community, by the existence of the Lake. This includes understanding just what are the societal and environmental benefits as well as the revenue to be derived from the existence of the Lake in Wagga.
- Create a more cohesive and dynamic working arrangement between the different Government Agencies responsible for the Lake.
- Engage with the Community on the progress of this Management Plan.

Recommendations Arising from this Management Plan

This Plan contains a number of recommendations that represent the action tasks to be undertaken during the life of this Plan. A brief summary of what are seen as some of the primary recommendations that must be delivered within the life of this plan, is set out below:

1 That Council and the Community adopt the interim goal of working towards retaining Lake Albert as a full recreational lake, till at least 2050, to allow the time required for the longer term decisions to be made.

2 That Council and the Community adopt the above targets as those appropriate for Lake Albert for the life of this Management Plan, and the delivering of the interim goal.

3 That Council jointly with the relevant NSW Government Agencies carry out a detailed study of the Lake Albert Catchment and derive from that study a new model for the performance of the Lake as well as a better understanding of exactly what is happening in the catchment. Thereafter a series of further actions will be developed to better understand the interrelationship between the Catchment and the Lake and potentially pursue newer more innovative control measures.

4 That Council seek to have Marshall's Creek de-proclaimed, so that it can pursue other stormwater harvesting arrangements that might be able to improve the interim performance of Lake Albert, and allow further top up the Lakes water supply in drier periods.

5 Carry out a detailed engineering study of all of the stormwater harvesting that is possible in the Lake Albert area, if Council is successful with the de-proclamation. Have that study explored collectively with all of the other Governmental Agencies that share management responsibilities for Lake Albert.

6 Install an automated Lake top water level monitoring device that will provide daily data that will link with recommendation 3 and allow a much better understanding of what is happening in the catchment and

what rainfall translates into runoff (and how much) at the Lake. It will also be a more definitive guide as to just when the rural catchment yields water into the Lake.

7 Explore what Governmental agencies may have funds available for the removal of sediment from the Lake, and any of the other actions being pursued, in this Management Plan. Apply for those grants as appropriate.

8 Construct sediment arresting mechanisms on Crooked Creek in an effort to reduce the volumes of sediment being directed into the Lake each year.

9 Review land use planning arrangements in the Lake Albert area particularly the need for wetlands and rainwater tanks, to explore if more runoff can be generated than is currently being generated. This task however needs to wait on the release of a Soil Conservation review of the Stringybark Catchment before proceeding, as that study may have direct ramifications on this recommendation.

10 Seek to explore if some representative community body can be established to provide improved communication between Council (and all of the other Government Agencies) and the users of the Lake.

11 Have a study carried out to determine more formally, what are the benefits to the wider community (at the triple bottom line), arising from the existence of Lake Albert in Wagga. This study should as such include identifying what revenue is derived by the community from those benefits with some assurance so that this figure can be comfortably be used by all in future analysis pertaining to the Lake.

12 Open dialog with NSW Fisheries over the possibility of constructing a number of deep holes as fish habitats in the Lake to allow the Lake to remain stocked, when top water levels are low, given that some body of water is likely to continue to exist. It is recognised that this will require significant input from the other Government Agencies with managerial responsibilities for the Lake, as well as detailed studies of the Lake's bed and sub layers so as to not compromise any lake/ groundwater interrelationships.

13 Have a local Flood Management Plan developed for the Lake Albert area given that one of the key roles of the Lake is as a flood mitigation structure.

14 Establish a broader community engagement strategy for reporting on progress through the media, newsletters, progress reports to Council and an annual forum for reporting back to the community against this Management Plan. The forums should also record community feedback, so that this feedback can be accommodated in this, and subsequent Management Plans.

15 Establish a Lake Albert Management Plan reference group, made up of Council staff, the Mayor and relevant State Agencies, to meet every six (6) months. The Lake Albert Community Committee (LACC) is to continue to meet on a quarterly basis, with an annual review. Two representatives of the LACC be nominated to attend the six monthly

reference group as a community link in monitoring the implementation of the Lake Albert Management Plan.

16 Facilitate a Community and Business Sector workshop to explore potential opportunities that could exist at the Lake and from that develop some form of master plan that may become incorporated into future management plans for the lake.

17 Establish a wetlands area covering 12-16ha at the northern end of the lake with a southern boundary in line between Lansdowne Avenue on the western side and Talbingo Crescent on the eastern side.

18 Establish a “Fish Zone” to extend 200m south from the boundary of the Wetland Zone and the full width of the lake, encompassing approximately 10ha.

A more detailed list of the actions and recommendations is included in each section, of the Report, and a general program of activities based on a priority and the need for pre-requisite activities is set out in Attachment No 5.

The content of the Lake Albert Management Plan (LAMP) considers and embraces important objectives contained in the Social, Economic, Environment and Governance themes in the Wagga Wagga Community Strategic Plan. This plan links with Council’s Local Environment Plan(LEP), environmental sustainability strategy, recreation and open space and social plan documents. While no objective should be considered in isolation there are a number of objectives that the plan links with and are relevant to the decision to develop the LAMP, being:

Social

1.1 A vibrant and attractive place that offers a range of lifestyle choices and a liveable environment
1.3 A broad range of leisure, sport, cultural and educational pursuits for the varying needs of the community
1.4 A safe, healthy and active community

Economic

2.1 A strong, sustainable and well balanced economy that generates growth and employment opportunities
2.2 Sustainable infrastructure and services that support current and future needs of the community

Environment

3.1 An integrated approach to water resource management
3.2 A sustainable built and natural environment
3.3 Sustainable management of natural resources
3.4 Promote environmental sustainability

Governance

4.2 Effective and transparent leadership that enjoys the support and confidence of the community
4.3 Council’s operations and activities are effective, efficient and customer focussed
4.4 Council has the necessary financial, human and other resources and management systems to provide appropriate services and infrastructure

1.0 INTRODUCTION

Council engaged Mr Cary Reynolds in 2009 to prepare the LAMP. Mr Reynolds was engaged on the strength of his experience and knowledge in integrated water management, engineering services and preparation of the previous Lake Albert Study (2006). The LAMP was developed to address three main questions:

1. What are the key issues facing Lake Albert and its long term sustainability?
2. To consider regulatory frameworks and other sector involvement with Lake Albert solutions.
3. How best to address Lake Albert water management issues and overall delivery of best practices for sustainability of the site area.

Mr Reynolds conducted qualitative and quantitative research. This research assessed available studies, research and data, along with engagement and consultation with key sector departmental officers, council staff and input from the Lake Albert Community Committee. Further community input was sought from the broader community through a public exhibition period held 9 November to 18 December 2009.

Lake Albert represents one of Wagga Wagga's most significant assets, one that is heavily utilised by many parts of the community in a number of different roles. These "roles" played the Lake, range across a wide spectrum of activities and include:

- A body of water, offering a wide range of active and passive recreational opportunities.
- A pollution control pond or sediment trap protecting the Murrumbidgee River from the flow of sediment that has historically flowed from an active erosion catchment. This volume of sediment is effectively equivalent in volume to 400 football fields around 400 mm thick of sediment
- A flood mitigation structure, protecting the downstream areas of the city. Historical data has indicated that this source of water has contributed to downstream flooding in the main parts of Wagga Wagga, particularly before the Levees and the Lake were constructed.
- A fish breeding ground, and whilst this clearly overlaps with the recreational functions, the Lake itself can be a safer habitat for the fish, less exposed to some of the pests that may be prevalent in the river systems.
- A potential source of income for the Wagga Wagga community particularly if it can become a significant tourist attraction.
- A source of water from the Wagga Wagga Country Club, and some small parkland irrigation by Council.
- A much sought after part of Wagga Wagga to live in with strong environmental and societal benefits.

As the result of an 1898 community decision, the "Lake" came into being, having been created by raising the levels attached to a natural spring to become a recreational lake. The Lake has now existed in that format for more then 100 years.

If the Lake were to be evaluated as a health patient (and evaluated against that 100 year old decision), then the Lake in its current condition would probably be sent home from work with a note stating it was unable to fulfil many of its primary functions, as it is:

- Ailing, due to a significant dehydration.
- Terminally ill, in that the ongoing accumulation of sediment will eventually see its life as a recreational lake cease, and its new life as a wetland commence in the not too distant future.
- Unable to perform to its full potentially in that its current evolvement has been more by serendipity and good intentions, rather than to any true plan, particularly in the face of new and emerging threats such as climate change.
- Parentless in that whilst there are so many bodies responsible for it, there has never been a truly defined management body that collectively takes the responsibility for its total development, and drives it towards what its full potential is.
- Evolving, recognising the Lake has been rapidly changing over the last 30 – 40 years with changes to the Catchment and the nature and number of inflow diversions attached to the Lake. This evolvement is likely to continue over the next 30 – 40 years, particularly with the emerging threats to the Lake.

Moving from such a poor prognoses for the Lake, to a position from where the patient is recovering, requires a little more than just a lot of rain in a short period of time. Rather this recovery for the Lake requires:

- A better understanding of the actual performance history of the Lake that has historically seen the Lake run dry around once every 20 years or so, but never with the duration that has occurred in the period since 2001.
- Some understanding of why the Lake is ailing and in particular, the role the catchment is playing in this dehydration of the lake.
- What can realistically be done to assist the Lake to recover?
- What can be done to prevent the current situation from occurring again in the future?
- Finding some way to recognise the full potential of the Lake, and then unleashing it, in partnership with the community.
- Seeing if it is possible to extend the life of the Lake, as a recreational body.

This Management Plan has been created to answer the above questions, as well as setting up some of the targets that need to be met ,if the Lake is to be maintained as a recreational lake. It has also been created to focus Council's attention on those tasks or actions that need to be carried out in the immediate future, to allow the long term decisions on the Lakes future, to be made.

As there is an urgent need to expand the body of knowledge required for such decision making and this management plan is intended as a plan of action to position

Council and the community to be able to make those decisions. The order and focus of those actions set out in this plan are based on the resources available to Council and the natural sequence of decisions that need to occur. The plan is also intended to be a vehicle by which progress on these actions can regularly be reported to the other governmental agencies involved in the management of the Lake and also as a means of better reporting to the wider community. As such it should become a vehicle for capturing further feedback and ensuring all views are acknowledged in the final management plan.

Finally it needs to be stressed that irrespective of the perceived value of the Lake, it is just another Wagga Wagga recreational asset that is very much in competition with a number of other community recreational assets for maintenance and improvement dollars that cannot realistically spread around all of these assets. Council as such needs to be convinced that these are the overwhelming community priorities funding such activities when rate rises are heavily constrained for Local Government.

What is clear at this time is that the future management of the Lake will need to exercise some degree of thinking outside of the more traditional approaches, if the Lake is to survive in anything like its current format.

Figure 1.1

Sediment Trap on Stringybark Creek Entry to Lake Albert

2.0 BACKGROUND

2.1 Overview of the Lake

The Lake is some 10kms south east of the civic centre with the Lake's current location arguably best described as being at the transition point between the rural residential and urban residential areas of the City. The Lake is easily accessed by the community from either Plumpton or Lake Albert Roads.

Major non residential assets on the Lake are the Boat Club and the Wagga Wagga Country Club. The Lake also has vast foreshore areas, traversed by a community walking track that circumnavigates the Lake, as well as including a number of picnicking or barbeque areas. An often forgotten area also attached to the Lake is the open space that also needs to be provided immediately downstream of the Lake, for when the Lake overflows or floods. This also includes the provision in Marshalls Creek for flooding in the section leading to the Murrumbidgee River.

Figure 2.1

Close Interrelationship of the Lake with the Urban Area

2.2 Lake and Catchment Statistics

Some of the basic details in respect to the Lake and its catchment are set out below, to provide a quick overview of the Lake and its typical performance.

- The Lake when full represents a storage volume of around 4GL (4,000 modern Olympic sized swimming pools full of water) and the Lake's volume equates to around one quarter to one third of the annual potable water demand for the urban City of Wagga Wagga (14,000 – 15,000 ML/annum).

- The Lake has a maximum depth of around 3.5 -3.8 m but in general would be considered to have an average depth just in excess of 3.0m. This maximum possible depth having been reduced from the Lake's original depth by the accumulating of around 1.0 m of sediment, from the catchment area over time.
- The Lake has a top water level surface area of around 121 hectares (at RL 191.5 AHD) but its base slopes very gently from the centre to the edges of the Lake, with the result that any significant loss of vertical height in the water levels can result in a significant reduction in this surface area of water.
- The catchment has a total area of 7,684/ hectares and is drained by Stringybark Creek as well as Crooked Creek, Cox's Creek and Boiling Down Creek. All of the latter combining as the Crooked Creek inflow. Refer Attachment No 2
- The Lake effectively traps silt from that catchment, preventing most of it entering the Murrumbidgee River.
- The Catchment has historically been the source of flooding in the downstream urban area but much has changed in the town's overall flood mitigation capability since the establishment of the Lake and the city's levees. The Lake however has been identified as having a flood mitigation role.
- Wagga Wagga suffers from urban salinity problems and it is not known if the Lake is contributing to these, nor indeed if the Lake may be contributing to the groundwater supplies for the city. However there is a very clear interrelationship between the drawn down lake and the groundwater table that will over time need to be better understood.

2.3 Catchment Topography

A May 1985 Soil Conservation Study on Lake Albert, describes the topography in the catchment in the following manner.

> *"The catchment consists predominating of moderate to low sloping lands (slope gradients up to 15 percent) described as lower hill slopes, foot slopes and interfluvial plains. The major water courses of the Crooked Creek and Stringybark Creek catchments have become deeply incised into the lower hill slopes and footslopes.*
>
> *In the south and southwest the land increases in steepness through lower hill slopes to extensive areas of the steep hilly terrain with slope gradients up to 33 percent and greater.*
>
> *The soils of the catchment are light textured or duplex soils of moderate to low fertility. They are all moderately to extremely erodible. The most erodible soils occur in association with the steeper landform elements in the south and southwest.*
>
> *Over half of the lands in the catchment are capable of regular cultivation. Although the dominant rural land use is grassing, there is only a very small area of proven grazing land (Class IV land) available. Thus much of the catchment is being used either beyond or below its capacity.*

The 1985 report also recorded the following in relation to sediment in the lake in 1985

- The average depth of recent sediment is 0.65mm or approximately 800,000m^3.
- In the period 1970-85 the average rate of sediment entering the lake was 53,000m^3 / annum

The report goes on to describe the catchment as easily the worst catchment in the Wagga Wagga region for erosion.

2.4 History of the Lake

The lake was initially created from a natural spring known as Swampy Plain, which was known as a reliable livestock watering destination, along the travelling stock route. Charles Gormley in his historical records of life in the Wagga Wagga region in the nineteenth and early twentieth century records the impacts of very severe droughts on the region, and the huge stock losses that were caused by these events. There were no upstream dams on the Murrumbidgee River in those days to regulate river flows as occurs now and as such it was common for the river to run dry during the more severe droughts. It was therefore often necessary to drive the stock to higher ground in these droughts and the Lake provided a source of water at the start of this drive, around the term of the twentieth century.

The 1985 the Soil Conservation Study of Lake Albert records that the "Wagga Advertiser" on 4th August (1898) stated that a project was being considered to divert water into the swamp to convert "*it into a splendid piece of water for all descriptions of aquatic sports as well as local water supply".*

The report also records that on the 10th of August 1898 a meeting of interested landholders was called, which resulted in the formation of the Lake Albert Improvement League. Three schemes were suggested at that meeting by which water might be diverted into the Lake.

1. Through a Governmental Reserve at the south west of the Lake (from Stringybark Creek).
2. By cutting a channel from Crooked Creek close to the Lake Albert Public School.
3. By deepening the entrance channel at the northern end and raising the roadway (Stringybark Creek).

Important dates from the history of the lake are:

- The 1969/70 diversion augmentation to Crooked Creek, so that all flows down the creek thereafter entered Lake Albert, replacing previous partial diversions.
- In 1976, the Tatton (Dandaloo) Drain was constructed to divert water from the area between Plumpton Road and Lake Albert to bypass Lake Albert and continue down into Marshall's Creek as a way of protecting residential developments in that area, from localised flooding.
- In 1977 the Stringybark Creek diversion, was completed, diverting all flows down that creek directly into Lake Albert.

- In 2004 the Tatton Drain Diversion was constructed to temporarily redirect urban stormwater runoff into the northern end of the Lake in an effort to gain more water

Based on the 1985 Report, the following aspects need to be noted in relation to the Lake's sediment history.

- The Lake has really only received full bed loads from the upper catchment areas since around 1977 when the final Stringybark Creek connection was made. Stringybark Creek was thought to have contributed some sediment since the initial 1932-35 diversions, but that contribution was considered to have been relatively small. Since 1977 the creek has contributed major loads of sediment.
- Crooked Creek has contributed some sediment since 1902, but in peak flows the major sediment laden water passed over a weir and flowed down the water course bypassing lake. Major sediment contributions from this source are considered to have occurred only since 1969-70.

That study concluded that the future of the Lake, as a recreational facility was seriously at risk based upon the above findings. The study suggested that if the rates of sedimentation continued, the Lake may be unavailable for recreation purposes in only 35-40 years [or 2020 to 2025].

Figure 2.2

Foreshore and Lake Interface

2.5 Boating on the Lake

Historically boating activities have ceased when it was considered there was no longer an accepted depth of water above the accumulated sediment for those activities to safely occur. This has effectively been based on when the top water level has dropped below preset levels and typically these points where boating activities cease have been:

- When the Lake effectively had only 1.6 m of cover over the sediment levels. When this reduction in water levels occurred, power boating was stopped, and it would appear that this arrangement has been rigorously enforced by the boat club. The actual arrangements are a little more involved than this basic depth arrangement, but for simplicity of operation this is effectively how the boat users have operated the Lake.

  This level is marked on the ramp at the boat club, for easy reference, and takes into account the Lake's sloping sides.

- When there is only 1.2 m cover over the sediment, then sailing activities ceased to occur and this level is also defined and enforced.

- Once sailing /water skiing is ceased, Maritime NSW had historically required that there be a water depth of 2.0m over the sediment, before boating activities recommence. This increased level took the guess work out of occasional events (i.e. re-opening and suddenly closing the Lake) just in response to a particular rainfall event.

Maritime NSW has however changed their minimum requirement to bring them into alignment with the provisions that exist on rivers, estuaries and other water bodies, whereby the Master of the craft is responsible for any decision as to whether it is sufficiently safe to operate the boat for the purpose intended. What is not understood here is what insurance provisions apply to the Boat Club and how these relate to these revised maritime requirements.

The other complicating factor here is even if a boat operator wanted to use their boat it is unsure if they could get their boat into the water. The Lake has retreated well beyond the Boat ramp and the sediment when saturate has poor bearing capacity. What is not clear is if these revised boating regulations will have provided any greater freedom, once the water levels rise and permit the return of boating activities?

There is a need to explore more fully what these revised arrangements mean for all associated with the Boat Club and then take whatever actions are required. It is suggested that these revised arrangements be one of the agenda items for the first meeting of any new management committee and then that they be discussed at length with the members of the Boat Club. Clearly the revised arrangements place increased importance on the need to ensure there are no impediments or snags in the Lake that may impact the use of these boats if opened at lower levels.

3.0 THE LAKE AND THE COMMUNITY

There can be little doubt that the Lake is a significant community asset that is much used by a large number of Wagga Wagga residents. The boating community's angst at the loss of this recreational capacity has been very visible in recent years (certainly since the Lake was shut again in August 2008).

Throughout the history of the lake the community has played a vital role in the development and maintenance of the lake. Together with relevant agencies and Council the community has expended considerable time and resources to address development and catchment management issues for the improvement of Lake Albert. In recent years the community have been involved in a number of projects including willow removal from the foreshores, tree planting, desilting at the northern end, clean-up days and facility improvements.

Understanding who the Lake's users are, how they use the Lake and what their expectations are, clearly form some of the essential components of any Management Plan, in relation to Lake Albert. This section explores these community aspects in more detail.

3.1 Nature of the Users of the Lake

Briefly the users of the Lake may be categorised by their usage of the Lake, direct or indirect, and they include:

- Water skiing (both social and competition).
- Sailing (both social and competition).
- Rowing.
- Canoeing.
- Various Organised Sporting Events.
- Model boat users
- Fishing
- Those that just enjoy the visual amenity of the Lake, and the surrounding flora and fauna, such as bird watches.
- Walking, jogging or bicycling around the Lake.
- Formal exercise groups.
- Picnicking (and barbeque) with a number of tables and BBQ's constructed around the Lake, for such a purpose.
- Commercial outlets such as boating sales that use the Lake to demonstrate their craft, motor boat fuel sales, fish bait sales, etc.
- The Wagga Wagga Country Club that derives water from the Lake, to irrigate the golf course but within defined extraction limits.

Many of these users have been denied the ability to use the Lake in all of the manners listed for some time in the overall period 2002 - 2009, with the result that some of the organised bodies such as the Boat Club are suffering considerable financial hardship.

3.2 Community Expectations

Council recently conducted an electronic survey of community members in respect to their expectations of the Lake and the results of the respondents are published in the following tables. Table 3.1 indicates that the need for increase water levels is easily the highest perceived priority for the respondents. It is assumed that water quality issues overlap with the water level issues, and this includes sediment transport into the Lake. However an examination of the responses to the survey questions does not provide sufficient detail to act as a guide to the community's perception or understanding of the scale of the threat that sediment transport posses to the long term viability of the Lake, particularly as a recreational water body.

It is understood that respondents were able to tick more than one box with a total of 5,125 boxes ticked by the 1392 respondents to this question.

	Action/Desires	**Respondents**	**Percentage of Respondents**
1	Higher Water Levels	1,215	87
2	Water Quality	936	67
3	Better Foreshores	668	48
4	More Shade Trees	637	46
5	Fishing Platforms	357	26
6	More Playground Equipment	336	24
7	Island for Bird Habitat	334	24
8	Woodlands Biodiversity Areas	320	23
9	Other (Café, fitness equipment etc)	179	13
10	Allow Lake to revert to Wetland	136	10
11	Nothing	7	0.5

Table 3.1

Responses to the Question "What will make the Lake Better for You"

In response to how residents saw the future of the Lake, there was a clear message that the majority of respondents to this survey wanted the Lake to be returned to its historical usage as a recreational boating lake. This was favoured by some 77% of the 1,378 respondents to this question as detailed in Table 3.2.

Again there may have been some confusion over the responses with 1,615 boxes ticked but review of the table A3.2 in Attachment No 3 shows that potentially up to 1,000 of the respondents used the Lake for boating purposes of one sort or another, and as a result the sample will be somewhat skewed.

	Action/Desires	Respondents	Percentage of Respondents
1	Recreational Boating Lake	1066	77
2	Other (Foreshore recreation, fishing destination, non motorised)	279	20
3	Left in a Natural State	270	20

Table 3.2

Responses to the Question "How would you like to see the future of the Lake"

When asked to prioritise Lake Albert against other potential recreational needs, the respondents placed Lake Albert at the head of the list, with 57% of the 1,053 respondents to this question favouring Lake Albert as the lead priority. To this question there has been clear preferences expressed with only 1,053 boxes ticked. However this was a survey on Lake Albert and this result as such is to be anticipated and as such cannot without verification be taken as representative of the wider community.

	Action/Desire	Respondents	Percentage of Respondents
1	Lake Albert	596	57
2	Other Roads Sporting Venues Murrumbidgee River	256	24
3	Riverside	96	9
4	Sport and Recreation	78	7
5	Arts and Culture	27	3

Table 3.3

Preferred priorities for how WWCC Funding should be Invested

The sample whilst providing more than useful feedback to Council is nevertheless a voluntary study specifically adopted to keep costs low to the ratepayers. As such these types of study tend to attract those that have a strong interest in the subject matter and the results may not be fully representative of how the average Wagga Wagga resident necessarily feels on issues pertaining to Lake Albert. As such it represents a quick snapshot, but without those balancing demographics.

To achieve a more representative sample would require an independent market research company specifically using their established practices to try and achieve a balanced sample of the community. This will be an expensive exercise, but will then allow for the appropriate "normalisation" of the results above.

The figures do however show strong community desire to have the old Lake Albert back and to be able to resume those recreational habits that the Lake used to host.

3.3 Community Preparedness to Pay

Restoring the Lake and protecting it into the future will have a price tag, and thus key to delivering any community espoused expectations, is the community's preparedness to pay the costs involved in respect to these expectations. When questioned on this issue in the same survey there was some support for a community levy, but the strongest initial direction was for Council to explore government grants when and if they were available. The total number of responses was 2,125 from 1353 respondents to this question, potentially the responses to this question could be a little skewed as some elected to tick more than one box whilst many confined themselves to a single box.

	Action/Desire	**Respondents**	**Percentage of Respondents**
1	Government Grants	1160	86
2	Introduce Levy	627	46
3	Reduce Council Services	226	17
4	Do Nothing	112	8

Table 3.4

Methods for Funding Lake Improvements

The figures in Table 3.4 are not a community mandate to do anything, as it has already been established that the figures are not a truly representative sample of the views across Wagga Wagga. The strong response to seeking other Government funding, along with the minimal consequences of taking such a direction would seem to warrant that being one of the key directions of this Management Plan should pursue. However before any of the other initiatives could be considered more seriously in response to this question, then a more representative survey will need to be undertaken, to confirm the community is indeed prepared to fund the sort of costs that will be involved in better guaranteeing the performance of the Lake.

3.4 Community Income from the Lake

There have been a number of figures suggested in relation to the financial benefits that retaining the Lake offers to the wider Wagga Wagga community, but none of those figures sighted in preparing this document could be substantiated or refuted. There is little doubt that they represent best attempts to quantify these financial benefits, it's just that there is no way to be verify the figures as calculated, short of an independent study to be conducted, by an appropriate financial expert in this area.

Quantification of the benefits is one of those pieces of information that needs to be known before a final decision can be made in relation to the ultimate role of the Lake. Hence it is suggested that a consultancy be let by Council and/ or Wagga tourism bodies to derive this figure with greater certainty. The consultancy will need to

explore the Lake under maximum usage conditions through to the minimum usage conditions, similar to those that exist at the time of preparing this Management Plan to ensure an accurate picture can be extrapolated. Potentially in seeking tenders on this matter, those experts being pursued can set out how they propose to gain a truly representative estimate of how much income the Lake may derive over say a ten year period as an evaluation method of determining the preferred contractor/consultant.

Figure 3.1

Recreational Facilities Looking Towards Apex Park

Once a draft paper has been produced it should be workshopped with the business Council/ Chamber of Commerce, any Tourism bodies as well as a wider community group to test its validity before finalising. This paper will then be used in subsequent decision making in relation to the Lake.

Ultimately this paper needs to also include environmental and societal benefits as well as institutional benefits, but the issue of revenue has been suggested as the place to commence, as it has been raised by a number of community groups and needs to have some agreed value sooner, rather than later.

3.5 Future Opportunities for the Community

The previously quoted survey or even just a stroll around the Lake on a pleasant evening will soon reveal just how well the Lake is used. Whilst this might be interpreted as strong use of the asset, the concern arising that needs to be further explored in the life of this Management Plan is to explore if the Lake (and its facilities) are all that they could be? One question that is not asked in the survey in relation to the Lake was “Is the Lake being used to anywhere near its full potential and is it deriving all of the benefits for the community it could?” Why this question is important is that to outsiders the Lake is one of the City’s best keep secrets, when it

has the potential to become a prime stop over for travellers on the Sturt and Olympic Highways.

However for this to occur:

- Travellers need to know of the existence of the Lake.
- There has to be a good restaurant to feed them, during the stop.
- There has to be sufficient information at the stop to let them have a short walk before resuming their journey. The Lake has a rich history and would make an interesting story on appropriate signposts at such a stopover point.
- The stopover has to have good access to quality toilets.
- A Children's play area should be in site of the parents having coffee or lunch.

Similarly why the question needs to be asked, is because at this stage of the Lake's development it would appear that it is only being used to a fraction of its capacity. Some other examples of what may be possible could include:

- Using Wagga Wagga's natural attributes of warm summer evenings and the natural amphitheatre that the Lake's foreshores creates to have a lake mounted stage for some evening outdoor performance. Even Christmas Carols could be conducted in this manner.
- Development of a high quality restaurant at the very edge of the water. Most cities have such quality restaurants or unique features. Examples include Doyle's in Sydney (amongst a host of others), the Boathouse in Canberra which is located in an identical situation to the Wagga scenario. This should not be seen as a criticism of any other restaurants or eateries in the area, rather it is too highlight a natural opportunity that exists for those that wish to be a little more entrepreneurial.

  The lower floor of the current Boat House may prove ideal for such a venture as there is already lots of parking for patrons and the evening use of this venue does not impede the clubs sailing activities. Indeed with the appropriate arrangement the restaurant may provide the revenue to keep the club viable, when there is a shortage of water in the Lake that denies the club access to its main revenue stream such as occurs at boating events.
- Construction of a coffee shop to cater for local patrons to make the Lake an even more attractive day out. This coffee shop could be worked in conjunction with most of the above ideas.
- Holding the world's largest model boat race from one end of the Lake to the other, even in a much reduced Lake.
- Much greater landscaping needs to be provided. There have been a number of trees planted recently but the need for shade to better enjoy the foreshores in summer is very real in the hot Wagga climate. There is presently insufficient shade to many of the more logical picnicking/BBQ areas and the use of deciduous trees should also be factored into this, to allow better all year round use of these facilities.

This Management Plan is aimed more at a management or engineering perspective and thus is not seeking to be an entrepreneurial guide on how to use or improve the Lake. The few quick suggestions above can be much improved on and have been included in this document just to highlight some of the untapped potential of the Lake. It is suggested that during the life of this Management Plan that a workshop be convened by Council, with invitees to develop an events calendar or a Lake expansion plan. This proposal is to try and tap into some of this potential that it is possible to derive from the Lake.

Figure 3.2

Typical View of the Walking Track in Close Proximity to the Lake

3.6 Accountability to the Community

Whilst one can wane over whether the 2009 Council survey is representative or not, one only needs to look at the recent news history of Wagga Wagga to understand that the Lake has aroused great passion, and even the number of respondents to a voluntary survey is indicative of this passion.

The community must be involved in the ongoing development of the Lake. Thus it is suggested that a key element of the community accountability that should follow this Management Plan, is that it should be supported by a formal annual progress report in an open community form. This will allow not just the tabling of progress against the actions recommended in the Plan, but more importantly it will also promote community input and allow that input to be recorded for the development of future Lake Management Plans as well as ant direct actions.

3.7 Finding Other Mechanisms for Improved Communication with Lake Users

One of the great difficulties in communicating with the various users is that there are few representative bodies to simplify this communication process. In 2005 when the Lake was examined previously, many of these user groupings appeared to fall under the umbrella of the Wagga Aquatic Users Group (WAUG). This group was formed in 2004 and had set itself the following goals:

- Drought proofing the lake.
- Making the foreshores attractive to the public.
- Creating user friendly parkland on the foreshore, to increase the use of the Lake's foreshores.
- Consideration of current and future uses.
- To consider water flows and the impacts of water quality.

In 2008 the Boat Club seem to have taken a community leadership role in relation to the Lake. This report does not necessarily advocate WAUG, the Boat Club or any other organisation as the Lake's user's representative body rather this is a matter for the community. However the concept of a single representative body for the community would greatly assist improved communication. It is therefore suggested that Council pursue this concept further with the community over the course of this Management Plan, particularly given that the current Lake Albert Committee, has a sunset clause attached to it.

3.8 Use of Signs at the Lake

The Lake has few signs providing information to the community scattered around the foreshores such as those required for warning if there are blue green algae problems. Adoption of a community notice board on or near the walking track may prove to be another method to improve communication with the users of the Lake.

If and when the Lake becomes more of a tourism stop over, signs explaining the history of the lake along with details may also be useful and should be located at the lunchroom or other as appropriate. However the potential for the signs to be vandalised is also recognised.

3.9 Conclusions and Recommendations on the Ongoing Community Involvement with Lake Albert

There is a clear community passion for the Lake (and its future), but capturing that passion and channelling it in the ongoing development of the Lake will be a great challenge for Council. As part of a movement in that direction, this Management Plan recommends that Council pursue the following actions during the life of the plan:

- A formal workshop is to be set up by Council to create a Development Opportunities Plan for the Lake and then seek to incorporate the outcomes of that workshop into future Council Planning and future Lake Management Planning. The meeting should include appropriate invitees with a business or entrepreneurial background, as well as the wider community.

- Hold annual open forums to report progress against this Lake Management Plan. The first of these meetings may be to table the plan in draft format and give the community the opportunity to input the plan before it becomes finalised. Subsequently the following meetings should occur at around 12 month intervals, unless there is a particular matter on which community feedback is sought, and this needs to occur outside this annual cycle.
- If the opportunity arises, seek to expand the Lake survey and gain a more normalised sample of the typical views of the average Wagga citizen towards the Lake. Thereafter determine how these vary from the sample results taken in 2009. It is recognised that the costs of these surveys are expensive and this would require that Council have a survey somewhat ready to go when an opportunity presents itself.
- Identify those government departments that may be able to assist with the actions set out in this Management Plan, particularly financial support and then seek from them what assistance they can offer.
- Have a professional financial study carried out specifically targeted at determining what are the real levels of revenue /income that Lake Albert derives for the wider Wagga Wagga community? Seek to then have that paper widely workshopped and then formally adopted as a guide that can be used for future decision making and have the focus of that paper moved to address the triple bottom line, rather than just the financial criteria.
- Explore with the community (Lake User groups) the concept of having a single peak representative body to allow for improved communication with Council and the overall management committee. The shape and nature of that representative body are details to be pursued through the course of this management plan so that the selected representative body can be featured in future management plans.
- Explore the concept of community notice boards at the Lake to improve communication to the general users of the Lake particularly for urgent communication.

4.0 FILLING THE LAKE

Lake Albert when full has a top water level of 191.5 m (AHD). However the Lake's actual top water level varies with time, based on rainfall in the catchment and the month of the year, noting the potential high summer evaporation. Since 2002 there has been protracted periods when the Lake has been unavailable for active recreational pursuits due to much reduced top water levels. When viewed against historical records it would appear that this period has contained some of the longest periods wherein these recreational boating activities have not been possible, and the driest consecutive set of years in the records studied.

4.1 Current Mechanisms for the Filling of the Lake

The Lake is currently filled under the combined impacts of:

- Rain falling directly on the Lake's water surface.
- Urban runoff from those areas directly draining to the Lake.
- The Tatton Drain Diversion.
- Runoff generated in the rural catchment and entering the Lake via Crooked Creek and Stringybark Creek.
- Possible inflows from groundwater, but probably only when the Lake is low, as the Lake appears to retain a small amount of water in it when evaporation calculations indicate that the Lake should have totally dried out. This groundwater /lake interrelationship mechanism, is not well understood at this time, and is discussed further in Section 4.4.

Tables 4.1 and 4.2 set out the respective rolls played by each of these inflow sources but most fundamentally they demonstrate that it is the rural catchment that is the most critical factor in being able to fill the Lake and sustain it into the future. Nevertheless in constructing these Tables, it is stressed that the figures contained in them are a guide only, based on annual rainfall from a Bureau of Meteorology site for consistency purposes. This has allowed records to be reviewed over a significant time frame. For these tables to be more meaningful, future contributions would depend greatly upon actual rainfall intensity and duration, where the rain occurred, catchment wetness etc. Considerably more information therefore needs to be tracked on a daily basis to achieve a more meaningful data set for the managing of the Lake.

Irrespective, the tables still clearly indicate that the Lake should easily fill in an average rainfall year, and to some extent this has been the actual experience of the Lake to date. However even in these average rainfall years, it still needs to be understood that there will still be some movement of the surface level of the Lake, as under summer conditions up to 1.0 m of evaporation can occur, when the Lake is at its highest Levels.

Inflow Source	Contributions in ML		
	Wet Year	**Average Rainfall Year**	**Drought Year**
Direct Rainfall	700	550	280
Urban Runoff	450 - 600	300- 400	100-150
Tatton Drain Diversion	500-550	380-430	140-200
Rural Catchment	10,000 - 14,000	4,000 – 8,000	0 -1,000
Totals	**11,650 - 15,850**	**5,230 – 9,380**	**520 – 1,630**

Table 4.1

Guide to Inflows into Lake Albert under Differing Rainfall Years

Notes

1. *The ranges shown in the tables are necessary to include because of the nature of rainfall intensity and duration, as well as catchment conditions can vary significantly. The likely output should be within this range, but in general the figures are considered conservative.*

2. *Actual experience of the drought conditions have been that there is no flow into the Lake in these periods, but it is still theoretically possible that there could be some inflow, if most of the rain in these years were to occur in consecutive cooler months. This needs to be understood even if highly unlikely.*

Inflow Source	Inflows as Percentage of Inflow Contribution			
	Wet	**Average**	**Drought (no rural inflow)**	**Drought (rural inflow)**
Direct Rainfall	5	7.5	49	17
Urban Runoff	3.5	5.0	22	9
Tatton Drain Diversion	3.5	6	29	12
Rural Catchment	88	81.5	0	61

Table 4.2

Inflow Contributions by Source

Notes

1 *The rural inflows at the top end of the range under drought conditions assumes an inflow of 1,000 ML occurs, during the winter months that*

year but as indicated before that tends to represent an isolated but significant storm that may generate some runoff an whilst possible would be out of step with actual experience.

If Council is to effectively manage the Lake, then there needs to be a mechanism that allows the surface levels of the Lake to be better tracked against both rainfall and evaporation, on at least a daily basis, and this needs to occur automatically to give us those more accurate figures.

Given that the Lake is used for activities such as water skiing and boating it is suggested that in seeking to build an automatic recording mechanism, no permanent structure should be built in the Lake. Rather a horizontal main be laid out to that area that is thought will remain permanently wet, and that main should be connected to a vertical pipe on the shore, where possible. Putting this measurement device in close proximity to the boathouse is suggested, as this will allow easy vehicular access and provide some security for the system. Readings should then be taken at least daily, and possibly more often, to allow much more informed analysis of the Lake's performance in the next Management Plan.

4.2 Factors Impacting these Filling Mechanisms

The manner in which these various water sources contribute to the Lake will depend upon a number of factors, such as the intensity of the rainfall and its duration, the periods of the year in which the rainfall occurs and the catchment wetness that governs runoff. Furthermore in seeking to better understand the catchment conditions, it needs to also be understood that the 7,800 hectare rural catchment has been an active erosion zone, and a number of control mechanisms have been constructed in the catchment, in the last few decades. These mechanisms will have decreased the runoff from the catchment in drier years, as it takes some water to fill these structures before any runoff can occur. If there is some time between rainfall events, then there will be a need to start again (in terms of filling these structures) as the original wetness will have evaporated off. However these erosion mechanisms are contributing to a significant decrease in the volumes of sediment being transferred into the Lake, and this sediment movement is the other major threat to the Lake.

In addition to the above more obvious impacting factors, there are also a number of other factors that will impact the rural runoff being generated into Lake Albert, and they include:

- The number of rural or farm dams have been constructed in recent years
- The NSW Government's "Basix" package for new homes that mandates a rainwater tank be fitted to properties wherein much of the normal rainwater runoff will now be trapped within these structures.
- Council Development Policy in the Lake Albert area that requires that wetlands be constructed for new developments, as a water quality measure.

What is happening in the catchment is discussed in more detail in Section 4.3, but it is suggested that the last two of the above matters need to be re-considered by Council over the life of this management plan.

The suitability of the "Basix" package in inland applications, where any stormwater runoff into the rivers is used for irrigation of food crops, needs to be questioned and could only be supported if there was a need to take pressure of the local stormwater systems. It is understood that this package is optional for inland cities but it is still suggested that Council officers review the suitability of these requirements in the Lake Albert area, with a view to re-directing these flows into Lake Albert, as a better means of supporting the Lake in drier years.

It is also understood that all new urban developments must have both some form of pollution control mechanism and a wetland that captures much of the runoff from these developments. The evolution of urban and semi urban developments in close proximity to and above Lake Albert have the potential to keep increasing runoff into the Lake in drier years thus it is suggested that Council's position on wetlands and ponds be reviewed by Council officers and a paper presented to Council within the life of this management plan. It is understood that this issue is complicated further by LEP requirements and the need for community consultation.

These requirements should be looked out from two perspectives:

- Is there still a continued need for the wetlands, given the need to increase flows into Lake Albert and the fact that Stringybark Creek has a silt trap on it. However further complicating this issue it is understood from discussions with Soils Conservation officers that the Stringybark catchment sediment is difficult to settle through the sediment traps and it is contributing to blue green algae problems in the Lake. As such that study may refute this suggestion. That report is due out in October 2009 and it is therefore suggested that the report be read and fully digested before proceeding further with the above recommendations
- Even if it was thought that the wetlands were needed at the start of the Development the outstanding question is should Council be giving consideration to allowing these wetlands/ storages to fill themselves, (without cleaning), or actively taking sediment from Lake Albert to fill these where they are in well developed areas. This is of course subject to the findings of the Soil Conservation report.

4.3 Filling the Lake 2000 -2009

Reference to Table A2 in Attachment No 1 demonstrates where there have been eight plus successive years of below average rainfall. As such some potential for the failure of the primary filling mechanisms to keep the Lake top water level high under low rainfall periods is understandable. The number of such prolonged dry periods has not historically been great with anecdotal feedback indicating some withdrawal of boating activities once every 20 years or so. The current period thus is unprecedented but the primary concerns will be that as the impacts of climate change come to fruition will the current dry period become more of the norm that the Lake will experience.

Since 1942 the period 2001 -2009 has demonstrated by far the highest recoded incidents of the failing of these primary filling mechanisms. This period has had:

- 8 plus continuous years of below average rainfall.

- 3 of these 8 years are amongst the seven driest years in the records period covered by the table.
- As at 30 June, 2009 was just 3.3 mm above the driest recorded year in the period (1967).
- Effectively the rain falling over the period has translated into the fact that there has been the equivalent of two years of average rainfall that has been lost over this period.
- The Lake still managed to fill to overflowing in 2005 despite there not being average rainfall in that year.
- In 2005 it took around 100-120 mm of rainfall to pre-wet the catchment in the minimum evaporation period before there were flows from the rural catchment that entered the Lake.
- It is understood that the Lake closed in late 2003 and remained that way until October 2005. It closed again in August 2008 and has remained closed up to the date of developing this management plan.

Based on this brief analysis of Bureau of Meteorology (BOM) records, this period since 2001 is the driest continuous period, with the closest to these conditions appears to be the 1940's, which was also a notable dry period for the region. Hence the levels of frustration with the low top water levels in this period are more than understandable.

Table A4 which covers the period 2000 to mid 2009 in more detail, records three or more consecutive months when there has been above average monthly rainfall, as this can be where sufficient pre-wetting of the catchment may occur, to allow some runoff. Basically this period has indicated the following:

- There appears to have been some minor inflows into the Lake in 2003 when 197 mm of rain occurred over three months, however tracking this is difficult as there are no effective records of surface water levels during this period that have been found in preparing this Management Plan. This rainfall occurred in those minimal evaporation months for the Wagga Wagga area and some inflow as a result of this is a logical extrapolation based upon this and a few observations made at that time. However it would have been expected that the overall volumes contributed to the Lake would have been relatively small and soon lost to the overall evaporation occurring at the time.

- The lake filled to overflowing in 2005 when 353 mm of rainfall fell over four consecutive months again in what are the minimal evaporation months [June to October].

- There was no inflow into the lake in 2007 -2008 despite four consecutive months of above average rainfall, with a total of 287 mm of rainfall in that period. This occurred in period November 2007 till February 2008.

It is recognised that the figures in these tables are based on monthly rainfall figures at a Bureau of Meteorology site that is not specifically in the middle of the rural catchment. As such the figures are potentially not fully representative of exactly what is happening in the catchment. Rather the Table is only a guide as to what is happening in the catchment. Wagga residents certainly recall a significant storm in

October 2005 that appears to have converted to significant runoff and finished off the filling of the lake, and even generated sufficient runoff to overflow the Lake.

Importantly the figures do raise some questions that need answers such as why didn't flows in 2007 -2008 result in some inflow into the Lake from the rural catchment. Possibly it is nothing more than the fact that this rainfall has occurred during the highest evaporation months not allowing the catchment to have become sufficiently saturated to allow for runoff. However it was also a reasonable expectation with as much rain as actually fell in those months that there could have been some inflow into the Lake.

Given the critical nature already identified in terms of the rural catchment's role in filling of the Lake then logically the most critical aspect in moving forward with the management of Lake Albert is the need to better understand what is happening in the catchment. It has already been noted that there have been significant erosion control mechanisms constructed in the catchment in recent years along with the construction of a number of rural dams. It is appropriate that with more innovative catchment practices evolving with time that the catchment be looked at with a critical perspective to see if more runoff without sediment can be generated.

What is not clear is the full extent of these works and if there is any potential to improve the water harvests from the pollution control ponds in the drier years. Hence a study of the catchment as it is now, needs to occur as a priority activity so it can be a key input into:

- The development of new management models for the Lake.
- Determining just what is the likely runoff that will be generated from the catchment for the Lake. It will be a guideline for Council and the Community in considering any supplemental makeup of water from other sources.
- Flood Mitigation, which is another key role that the lake performs and as Australia has a history of ending dry periods with rather extreme wet weather periods, this surprisingly may become the critical factor for Councils management over the next decade or so.
- The evolvement of future management plans.
- Identifying any other areas Council and the NSW Government need to focus on.
- Setting up a management team with the other NSW Government Departments, to more closely monitor the Lake.
- Answering a lot of community questions in respect to the performance of the Lake.
- It will be a perfect adjunct to the proposed close monitoring of Lake top water levels, already suggested.

It is critical that this study be done in conjunction with the NSW Government Department that share management responsibilities for the catchment to ensure a consistence of approach and the opportunity to ensure there is no confusion between any of the bodies. To that end it is suggested that Council formally write to the Minister and request a joint project team be established and this work proceed as soon as possible.

4.4 Return to Swampy Plain

Early recorded history from notable local identities such as Charles Gormley record that in the droughts of the 1800s that livestock were driven to the higher country in an effort to get them water and that the Lake was an ideal jumping off point on that trek. The Lake or "Swampy Plain" as it was known then as it was then appears to have been considered as a reliable source of water for these livestock, before a decision was made at the turn of the century to turn it into a recreational Lake. The body of water as such is and has been something of a natural spring apparently fed by groundwater in a manner that has never been determined in detail.

Figure 4.1

Swampy Plain?

Observations of the Lake since 2000 have shown that the lake does not totally dry out but rather seems to retain a small amount of water in the base of the Lake (albeit at a much reduced level with around 0.7 m or a little more). In short it appears to be returning to its "Swampy Plain" nature being feed by this interrelationship with the groundwater table in that location. As such it is probable that even if the drought continues that there will be little further changes to the water levels in the Lake and there will always be something of a Lake for passive recreational purposes. Studying this interrelationship is recommended but is not seen as a high priority item for this Management Plan rather it should become an action to be held over to the next Management Plan. This plan needs to concentrate on providing that data that will be required for the decision making on the Lake's long term directions.

This revelation that the Lake will retain some water does however open up some opportunities to leave fish in the Lake and potentially even continue to restock the Lake even when the top water level is low. Prior to the rainfall in 2005 the Lake was electro-fished to try and protect the fish that were in the Lake at that time. Some large

Murray Cod were reported as being captured and released into other water bodies. However if that total drying out potential is not likely to be realised then there is an opportunity to explore the construction of a number of deep holes for fish habitat to work in conjunction with this “swampy plain” aspect. It is suggested that discussions on this matter with NSW Fisheries be held and that the two parties develop recommendations to put before the suggested Management Team to be formed. The proposals can then be explored from all possible angles and in particular the potential for damage to the groundwater Lake interface that must be protected. Potentially there may be some financial support for such a proposal or at least the studies that will be required before proceeding with such a suggestion.

The construction of these deep holes will also allow some better opportunity to remove silt from the Lake because the downside to this inner lake remaining is that the removal of all of the silt from the Lake will require wet dredging and thus removing the silt is likely to have a significant price tag (refer section 5).

4.5 Filling the Lake (General)

Given that Lake history tells us that the natural filling mechanisms will periodically fail and insufficient detail is known in respect to the impacts of climate change on the Lake, this management plan explores in the following sections, those other options to fill the Lake. These options include:

- Filling the lake with raw water from the Murrumbidgee River by pumping it up to the Lake.
- Filling the Lake with treated sewage effluent from the nearby Kooringal sewage treatment plant.
- Harvesting increased areas of urban stormwater, and redirecting that water into the Lake.
- Filling the Lake with Groundwater.

Council needs to have determined if it is financially, economically and environmentally appropriate to pursue any of these options and arguably there will be a need to concentrate resources on those options, more likely to be affordable or acceptable to the community.

4.6 Filling the Lake from the Murrumbidgee River

The Murrumbidgee River represents one of the more secure river supplies in inland NSW with significant irrigation and high security releases down it, from a series of upstream dams during the October to May irrigation period, each year. The size of these irrigation releases have been significantly reduced over the 2001 -2009 period, with effectively few years (if any) in that period when a full general security allocation has been permitted, and with some allocations reduced to zero or near zero.

4.6.1 Details of this Proposal

The key elements of this proposal will be:

- Access to Murrumbidgee River water in the first instance, for extraction purposes.

- Some form of extraction mechanism from the River.
- A pumping station to move the water from the River to the Lake
- A pipeline from the River to the Lake, probably somewhere between a 375 mm main to a 450 mm in size over a length of around 5,500 m.
- An outlet arrangement that allows the dissipation of energy into the Lake with out erosion or bank damage, and at the same time is a structure that is safe from a navigation perspective.
- A meter to measure flow through the pipeline and ensure that any extracted volume stays within the set Council allocations and is paid for on the basis of that metre.
- A clear policy in relation to how the filling the Lake from the River is to occur. There needs to be a well defined protocol that guides this operation, and any of the other sub-options to be considered.

This option also rotates around two further critical factors:

1. How fast the Lake needs to be filled.
2. The availability of water when it comes time to commence the pumping. It is assumed that such pumping will need to occur whilst the irrigation releases are occurring, but ideally the Lake should be filled during winter.

Water needs to be pumped into the Lake at a rate of around 200L/S to minimise evaporation losses, whilst the Lake is filling and therefore the volume that needs to be pumped is minimised. This filling flowrate is the basis of the above suggested sizes of pipe.

To sufficiently fill the Lake to a level where it could be used again for active recreational uses will require around 2,000 ML but it is stressed this will not be sufficient to totally fill the Lake rather it will fill it to a level around 0.6 -1.0 m below the maximum top water level. This will leave some space accommodate rainfall generated runoff if it occurs.

If this refill mechanism was to be established as a long term permanent arrangement then pumping would commence at a higher level than is currently the case and volumes requires to top up the Lake to similar levels would be reduce to around 1,000 ML/ cycle.

4.6.2 Gaining Access to the Water Required

There are some misconceptions over whether sufficient water can be obtained and the role of water regulators in respect to filling Lake Albert. The bottom line is that the water can effectively gained through an open market approach, with the regulators not the determining body for who procures the water. Rather they regulate the actual volumes of water that will be released from the dams and as such, how much of the allocation can be used by those extracting the water.

This procurement of water can effectively happen in one of three manners:

- It can be purchased under general security allocations when these become available and to gain this access to the general security water supply, Council will need to secure an allocation, as well as pay an annual usage fee. These allocations are purchased as they become available in the water market place, as all of the water has been allocated and much of the focus of State and Federal Governments has in recent years been about reclaiming the over-allocation.

  However when these general allocations are purchased this will then give Council access to the water on a permanent basis and hence any subsequent usage of the water will occur at a much reduced cost, effectively the annual usage cost.

  The difficulty with this water supply is that under drought conditions the allocation may only be a small percentage of the actual allocation Council holds and if Council wanted to guarantee 2,000 ML it may need to purchase up to 20,000 ML of allocation (or possibly even more). It is also possible that in some years there may be zero allocations for general security.

  Some of this purchase cost can be offset by on selling this water when it is not required for the Lake (and this should be the normal case) and that will be a complex calculation that exists outside of this Management Plan. A brief estimation of the costs to procure the water allocations under this option are set out in Table 4.3 as a guide to the sort of up front costs that may be involved with this option, depending on the level of security to be pursued.

  Acquiring the total volumes of allocation sought by Council and the community may take some time to achieve so this will not be an activity that can be contemplated just at the start of a drought but something that needs to be built up over time. This is the basis of the report's previous references to the on-selling of this water when not required by Council.

Pumped Volume (ML)	**100 % Allocation ($ x 1,000)**	**50% Allocation ($ x 1,000)**	**10% Allocation ($ x 1,000)**
2,000	2,400	4,800	24,000
1,000	1,200	2,400	12,000

Table 4.3

Likely Costs to Purchase General Security Water

Notes

The table indicates the likely costs based on the levels of allocation that are purchased. The 50% allocation for example requires that Council purchase 4,000 ML of allocation to allow for a reduced allowance i.e. if there was only a 50% allocation Council it would still have available 2,000 ML of water, however if there was a 25% allocation Council would only be able to pump 1,000 ML despite the allocation purchased.

The typical cost of general allocations in 2008 -2009 has been between $1,200 -1,300 /ML but these costs are extremely variable with time and the figures in the table should be used as a guide only.

- Water can be purchased on a one off basis by procuring it through a water trader to capture that water that is insufficient for others to use elsewhere but this can be purchased as a number of sub lots. As such there must be a question mark over the volume of this water that can be secured at a particular point in time.

Pumped Volume (ML)	**$250/ML ($)**	**$500/ ML ($)**
2,000	500,000	1,000,000
1,000	250,000	500,000

Table 4.4

Likely Costs to Purchase One off Water Supply

Typically this water has been selling for between $250 - $500 /ML but when a large purchaser, such as Council, enters the market place, then prices will tend towards the higher end of this scale. Indicative costs to purchase sufficient water for a single filling of the Lake would be as set out in Table 4.4. To these costs the capital costs of the pumping station and pipeline will need to be added.

- It can be purchased under a high security allocation and this would be similar to the general application discussed before, excepting that the costs would be considerably higher in terms of the cost per ML of such an allocation. Offsetting this is that these allocations are much more secure and there would not be the need to purchase significantly more than the 200Ml sought. Typically costs are of the order of $3,600 - $4,000 ML and the cost to Council are set out in Table 4.5

Pumped Volume (ML)	**$3,600/ML ($x1,000)**	**$4,000/ ML ($x 1,000)**
2,000	7,200	8,000
1,000	3,600	4,000

Table 4.5

Likely Costs to Purchase High Security Water Allocations

High security allocations are however much more difficult to procure and it is severely doubted that Council will be able to secure these allocations in the quantities sought to be able to fill the Lake.

4.6.3 Option Costs

It is estimated that the capital costs for the extraction and delivery mechanisms will cost around $5 Million at 2010 rates and to this needs to be added the costs of procuring the water. Briefly the likely costs for the different options are as set out in Table 4.6 and reduced to the likely costs per rated household.

The one off fill is the lowest cost option, but it does seem that spending all of the money on the capital works for a one off occurrence is inappropriate and still runs the risk that the water may not be there when it is required.

The higher security supplies are a lesser cost than the general security water but it is doubted that Council will be able to secure those volumes of water required for this option at high security. This is a matter that can be pursued through water traders, if Council wishes to pursue this option further.

Notes in relation to Table 4.6

1 *The table assume 25,000 ratepayers in Wagga Wagga*

2 *The table assumes Council will pay interest rates of around 7-9 % over the life of the loan involved with the particular option.*

Option	**Estimated Cost ($x 1,000)**	**Cost per Rate Notice ($)**
One off fill of 2,000 ML	6,000	430
On Off fill of 1,000 ML	5,500	395
General Security Purchase of 2,000 ML	7,400	510
General Security Purchase of 4,000 ML	9,800	705
General Security Purchase of 5,000 ML	11,000	790
General Security Purchase of 10,000 ML	17,000	1,220
General Security Purchase of 20,000 ML	29,000	2,090
High Security Purchase of 2,000 ML	13,000	940
High Security Purchase of 1,000 ML	9,000	650

Table 4.6

Summary of Sub Option Costs

General security options run the highly probable risk that only a percentage of the allocation will be permitted in drought years and if the 2008, 10% allocations were repeated, then 20,000 ML of allocation would be required. Thus to have an effective long term solution will see costs range from $17 Million to $30 Million. Cost per rate notice, as such are quite high and Council has no mandate to expend these levels of funds.

The costs of the infrastructure are estimated on the basis of a permanent structure and may be able to be reduced for a less permanent structure such as may be contemplated for a one off fill scenario.

4.6.4 Other Factors to be Considered in Proceeding with This Option

This option will, if sufficient water can be procured, fill the Lake to an acceptable level. However there are a number of other factors over and above costs that need to be considered in determining whether to proceed with this option. These include:

- If there is any virus or bacteria in the river than cannot be transferred into the Lake as it may be dangerous to fish life. ACTEW for example will not pump water from the Murrumbidgee River into one of its dams that is essentially next to the river. It is understood that this is as a result of some fish virus that it does not want to have spread into the Cotter Dam despite the fact that it is understood that pumping into the dam is probably by far the best engineering option for ACTEW.

  This management plan has not carried out this level of investigation and these potential viruses are a matter that will need closer consideration before this option can proceed.

- All of this pumped water comes from the total allocated water in the Murrumbidgee River and it needs to be realised that this 2,000 Ml represents between 500 and 1000 hectares of lost irrigation based produce. Based on a crop such as tomatoes this represents the loss of around 75,000 tones of tomatoes, and as such the loss of this amount of food production represents the equivalent of the food to supply many thousands of people. Similarly in intense agricultural such a volume of water also represents the loss of around 60 jobs.

  The figures on tomatoes are provided as a further guide only as they are a product that everyone would be relatively familiar with. The real difficult with this option would be in justifying the use of this water for boating and water skiing when other food growing irrigators are being restricted to 10% of their allocation. Wagga residents would to some degree be setting themselves up for that news story that tells how they are squandering water, simply because they have the ability to purchase it, when the rest of the country is doing it tough.

- The best period to fill the Lake would be during the period May to September when evaporation is at its minimum but this is also when there is minimal water in the river as there are no irrigation releases occurring. It is possible that it may be difficult to extract 200L/S at times during this period in drought years.

4.6.5 Conclusions this Option

It is suggested that this option should not be explored further during the life of this Management Plan primarily because of the costs involved and the societal consequences of proceeding with this option. The lowest cost sub options are of the order $6 Million and the more secure options are around $30 Million.

It would appear that there are better other alternatives that should be pursued first in the limited period of this Management Plan. Similarly much more should be learned in relation to the performance of the catchment before this option is pursued further.

Figure 4.2

Top End of the Diversion into Lake Albert during Mid 2005 Rains

4.7 Filling the Lake Using Stormwater

There is already some stormwater diversion occurring through the use of the Tatton Drain Diversion and in drought years this is adding up to 200 ML to the Lake and up to 430 ML m in average rainfall conditions. The difficulty with this option is that the current Tatton Drain is not safe from an engineering perspective. In the advent of a

large inflow (large rainfall event) there is the potential for water across the road and /or wash out of the road where the culverts are.

Council is already moving to put a more permanent structure in place that will see some overtopping in higher rainfall events and this will render the current arrangement much safer. However a brief study of the stormwater mains in the area near Lake Albert reveals there are a number of other stormwater mains that discharge into Marshalls Creek downstream of Lake Albert.

It would be possible to constructing a weir across Marshall's Creek further down towards Vincent Road to trap that water and then pump it into the lake effectively allow the urban runoff for the area west of Kooringal Road up to the ridge line to be now drained into the lake. It will also pick up any overflows from the Tatton Drain.

There are also a raft of other stormwater harvest options that could be pursued and based upon the results of the Council survey carried out by Council in 2009 it would appear that this option enjoys by far the greatest community support, hence the option is pursued in greater detail below

4.7.1 Details of this Proposal

This option capitalises on the fact that Marshall's Creek is quite flat and that it should be possible to back flows up along the creek bed back to a pumping station, located near Lake Albert Road (i.e. near the Lake headwall). A flood type pump would then be located in the pumping station to effectively lift the water up into the Lake Albert whilst it was raining. Further in support of this proposal would be the plans to lay a 450mm pipeline under the creek bed to pick up on those small rainfall events that the backing up of the water may not be able to capitalise on particularly with the loses in initially wetting the creek bed. The pipeline would allow these low flow events to also be pumped back into the Lake. This arrangement is shown in figure 4.1.

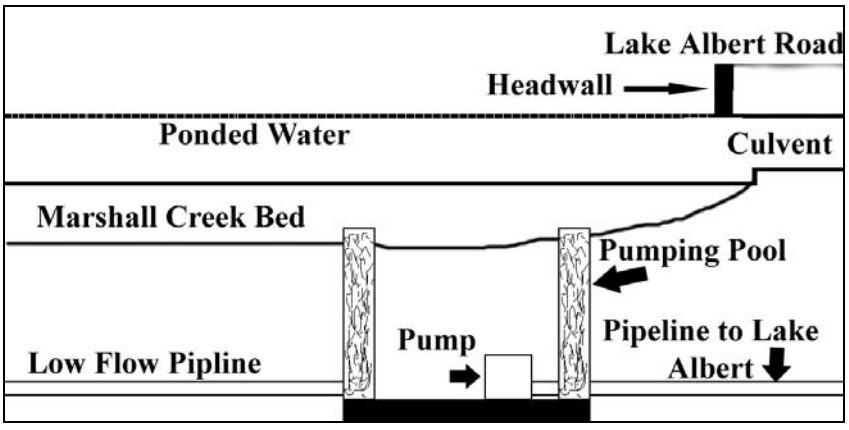


Figure 4.1

Elevation View of Pumping Pond

However Marshall Creek is a regulated Creek and proceeding with this option would require significant approval from other bodies for Council to extract this water. It is included as a guide only as to what may be possible.

4.7.2 Volumes of Water Available

Table 4.8 provides a guide as to the levels of inflow that may be generated from this area under the differing conditions with conditions between these fixed points to be extrapolated. For example in one of those 85-95 % years that seem to feature quite often based on the historical records in Attachment No 1 then a further 500 Ml should be capable of being added to the Lake. However it also needs to be remembered that from the other areas there is potentially much more water now entering the Lake as per Table 4.9.

Weather Condition	**Estimated Flowrate (ML)**
Drought Years	300
Average Rainfall Years	600
Wet Year	800

Table 4.8

Estimated Flow Generated from a Marshall's Creek Weir

Including these additional figures in the rainfall generated inflows gives the following guide as to the performance of the Lake with these revised stormwater provisions.

Inflow Source	**Contributions in ML**		
	Wet Year	**Average Rainfall Year**	**Drought Year**
Direct Rainfall	700	550	280
Urban Runoff	500-600	300-400	100-150
Tatton Drain Diversion	500-550	380-430	140-200
Marshall Creek	800	600	300
Rural Catchment	10,000 - 14,000	4,000 – 8,000	0 -1,000
Totals	**12,500 - 16,650**	**5,830 – 9,980**	**820 – 1,855**

Table 4.9

Guide to Inflows into Lake Albert under Differing Rainfall Years

The Lake is now getting up to 820 ML of inflow in drought conditions and potentially up to 1500ML per annum on those years between drought and average rainfall, which would do much to restore the Lake even if it can not fill it. If one is to look at the number of 80% years in Table A2 then there is some hope that these years will in future do much to halt falling Lake levels.

Clearly a detailed engineering study needs to be done to determine just what can be done in terms of stormwater harvesting and redirecting flows and that requires a level of study that lies outside of this management plan. It may be possible to increase these non rural catchment flows to over 1000ML /annum but it is impossible to conclude this without such a detailed engineering study.

4.7.3 Regulated Marshalls Creek

As indicated Marshalls Creek is a regulated creek and this will restrict to a large degree what Council can and cannot do in terms of stormwater harvesting. As the only irrigator on this creek is Council, which uses the water (plus treated effluent discharged further upstream into the creek) to water the EQUEX centre. As such it may be possible to have the Creek de-proclaimed so that Council has some freedom to pursue other stormwater harvesting options. It is therefore suggested that Council write to the NSW Government and seek this de-proclaiming of the creek and if successful then carry out a more detailed engineering survey of just what is possible in terms of stormwater harvesting in this area.

That survey would then be the basis of any further works to be pursued in terms of filling the Lake.

4.7.4 Cost this Option

The typical costs to build a very simple weir across the creek and the pumping station etc would be of the order of $1,000,000 to $1,500,000 but cost could soon rise f there are unforseen difficulties hence there is a need to look more closely at this option before proceeding. Overall it should be possible to complete a reasonable stormwater harvesting project for around $3,000,000 with it possible to stage the works such as there should be some ability to avoid the need for borrowings to fund much of the project. As such the cost of this option is likely to be of the order of $120 -$150 per rate notice for the capital costs.

4.7.5 Other Factors to be Considered in this Option

This water is not included in the allocated water and much of it will be lost in the flows down Marshal Creek. More importantly this water is not taking from the allocations of others and is in an area where the Government has been keen to see more stormwater reuse projects. Wagga Wagga generates an estimated 15 GL of additional water as the result of the construction of the city with its considerable hardstand to generate additional runoff. This would simply be some reclaiming of some of this runoff for city usage. There can be no doubting that the additional water flowing into the Lake would assist greatly with better controlling blue green incidents in the Lake.

If the creek was de-proclaimed then Council would take full responsibility for the creek downstream of the Lake, and whilst this may seem to be some increase in risk the simple reality is that Council already takes that responsibility as it is the body with day to day responsibilities for the creek.

The de-proclamation would also secure the irrigation of EQUEX into the future without the need to apply for irrigation releases or the threat of losing

that license and having then to pipe effluent to the complex from the STP as opposed to using the less expensive run of the creek.

4.7.6 Conclusions this Option

During the life of this management plan it would appear that there is considerable benefit in proceeding with:

- Having Marshall Creek De-proclaimed
- If successful carry out a detailed engineering survey on just what is possible in terms of stormwater harvest. This will also include societal and environmental implications of any proposed options.
- Work through the stormwater harvesting with the other Governmental Agencies responsible for Lake Albert, into a final submission to Council
- Proceed with some of the elements of that harvesting program if they are sufficiently advantageous to merit proceeding with.
- Complete the new Tatton Drain Structure as a matter of some urgency.

4.8 Filling the Lake Using Treated Sewerage

The nearby Kooringal sewage treatment plant would seem an ideal source of water but much of its summer output is already used for irrigation in other areas. The great difficult with this option is that the effluent that will be produced by the Kooringal STP is Class B Effluent and the quality of the treatment would need to be raised to Class A if it were to be discharged into a recreational Lake. Ballarat for example uses 600 ML /annum to try and tip the balance in its favour at Lake Wendouree.

4.8.1 Details of this Proposal

Proceeding with this option will require:

- Augmentation of the STP
- Pipeline approx 2,000 m in length
- Pumping Station
- Outlet structure in the Lake
- Close Monitoring Program

4.8.2 Volumes of Water Available

There are around 900 Ml of effluent that would be available and if this source were of an acceptable quality it would clearly make a difference to the Lake in terms of slowing the drop in top water levels. However it will be insufficient to fill the Lake when it becomes drawn down to the volumes it has in mid 2009.

4.8.3 Blue Green Algae

On of the difficulties of using treated effluent, even Class A effluent, is that it will contribute to the build up of nutrient levels in the Lake and with no regular flushing it has the potential to see the lake closed for much longer times than it presently. Indeed this option could result in the paradox of considerably more water available in the Lake but the boat users still unable to use it. That may make it something of the last straw

4.8.4 Cost of this Option

This option is likely to cost around $10,000,000 -$12,000,000 in capital costs with an operating cost of the order of $200,000 per annum that will be ongoing. This equates to a cost per rate notice of the order $750 - $800 making it far less desirable.

4.8.5 Other Factors to be Considered in this Option

Given that the Lake is used for sailing and water skiing with a lot of human contact and there will need to be a consultative exercise conducted to ensure that the community will accept this water source into the Lake. It would not be unusual for communities to reject such a source when there is swimming and water skiing involved.

4.8.6 Conclusions this Option

Based on the above costs and the risks posed by the blue green algae this option is not recommended for proceeding with within the life of this management plan, rather Council would be better served by pursuing the stormwater options in the first instance. However Council could explore supplying the golf course with effluent not that this will take any real stress of the Lake, but simply because there seems to be so much in the way of wrong perceptions over how much water the course uses.

If it is not possible to provide effluent then the matter should be raised with the other bodies with management responsibilities on the basis that as the Club takes so little water why do the current restrictions need to remain, as they have no real value.

4.9 Other Mechanisms for Filling the Lake

Another option for filling the Lake is the use of Groundwater but there will need to be a detailed determination of just how much groundwater is available. It is doubted that it could be produced at the 200 L/S suggested as a more ideal flow rate to fill the Lake without it losing all of the water to evaporation.

Council has observed that in the bores used to maintain the groundwater for urban salinity problems the water retreats during the dry years and is not available for extraction. In addition there is the possibility that this may be tapping into the city's drinking water supply or the shallower Aquifer that already has around 4,500 licensed extraction points in it. All of these issues need to be better understood before any real groundwater options can be pursued.

It is suggested that Groundwater be pursued further in those management forums suggested in Section 7.0 of this Management Plan to try and provide some context so that it can be explored further.

4.10 Conclusions and Recommendations in Relation to the Filling the Lake

Maintain a lake at near top water level is all about maintaining the catchment and a starting place for this management plan must be about understanding in better detail just what is happening in the catchment. This also needs to be done in conjunction with all of the governmental departments and agencies that share responsibility for Lake Albert. Only when the catchments behaviour is understood can future management plans be more effectively targeted.

In support of this is the need for a better mechanism to record the Lake's top water level on a daily basis and compare this with rainfall, evaporation and maximum temperatures. Both of these initiatives will allow new management models to be constructed to guide Council on how to best manage the Lake moving forward.

In the period 2001 to 2009 top water levels have remained low for the longest protracted period recorded, hence a part of the future management planning will be about understanding how climate change may impact the Lake. Understanding the catchment therefore is a first step in that process as well.

Of the options to fill the lake from alternative sources it would appear that further stormwater harvesting would seem to offer the best potential option but a first step is to approach the NSW Government to have Marshall's Creek de-proclaimed as this will be required in this harvesting of additional stormwater. Assuming Council is successful in this area then a detailed engineering feasibility study needs to be carried out to determine exactly what is required to develop more reuse of stormwater.

Options to fill the lake by either pumping form the river or using treated sewerage are considered too expensive and have just too many environmental problems to merit pursuing within the life of this management plan. Accordingly this management plan recommends that the following actions be pursued during the 5 year duration of the plan.

1. Council should work closely with the relevant NSW Departments and Authorities to carry out a study of the rural catchment area for Lake Albert and better understand what is happening in that Catchment. This information can then be used to model the catchment and the Lake.

   It is understood that Council has already written to the NSW Minister for Water to request this joint study be carried out and thus this recommendation moves to one of Council ensuring that this study occurs, as soon as can be practically achieved and then that the findings be reported back to the Wagga community when completed.

2. An automated top water level monitoring device be designed and constructed at Lake Albert again as soon as possible. It is further suggested that Council take advantage of the low Lake levels, and lay the connecting pipeline to the wet area as soon as possible.

3 Council review the requirements for new properties in the Lake Albert Catchment to have a rainwater tank fitted and allow these homes to direct their run off to the Lake.

4 Council to review the requirement for wetlands to be constructed with new developments in the Lake Albert area. Similarly Council should review in existing developments where such wetlands exist, if these should be allowed to fill themselves in, over time or be assisted to be filled in with material that could be excavated from the lake. This review however will need to await the Soli Conservation study on Stringybark Creek to ensure Council has all of the facts to carry out the review.

5 Council explore with NSW Fisheries the potential for a few fish habitats to be constructed in the Lake given that the Lake seems to revert back to the Swampy Plain scenario which potentially can maintain fish life. A proposal should be taken back to a management meeting of all of the agencies with responsibility for Lake Albert.

6 Council should write to the Minister for Water or the Department of Environment Climate Change and Water as appropriate and seek to have Marshalls Creek De-Proclaimed so that further stormwater harvesting can be pursued.

7 Assuming that this de-proclamation is successful, Council will then need to carry out a detailed stormwater harvesting study to determine just what is possible and what the costs involved would be. Based on the results of that study it could develop this proposal with the other government agencies and put a proposal back to Council along with a program of works over time as it is expected this project will be broken down into a number of sub options.

8 Pursue the provision of effluent reuse for the Golf Club and if not successful re-raise the current extraction arrangements with the other agencies at the meeting of these agencies to overview the performance of the Lake.

5.0 ALTERNATIVE CAPACITY OPTIONS FOR THE LAKE

5.1 Current Status of the Lake

The Lake has around 1.0 m of sediment, accumulated from the catchments, scattered over its base. That equates to around a further year for boating activities under drought conditions, assuming the Lake starts from a near full position. Currently the maximum depth appears to be around 3.5 -3.8 m and with the Lake's base appearing to be generally flat with a very gentle gradient to the Lake's edges. The sediment essentially appears to be fairly uniformly spread across the Lake as it appears the sediment is relatively mobile. There is more land based sediment in the South Eastern corner, where Crooked Creek discharges into the Lake.

Discussions at officer level with Soils Conservation officers indicate that the sediment from the two creeks differs considerably in nature with the Stringybark sediment likely to be in suspension longer and potential a significant contributor to blue green algae problems in the Lake. Crooked Creek seems to produce more coarse sediment and that is supported by this visual sediment in the south eastern corner.

Other issues in respect to this sediment transport are covered elsewhere in this Management Plan with Section 5.0 focussing just on what would be required to give the lake greater life by increasing its depth.

5.2 Soil Conservation Study

During the passage of developing this Management Plan Council has become aware that Soil Conservation is carrying out a further study of the Lake based predominantly on Stringybark Creek. It is understood that report will significantly update their 1985 report. Thus it is strongly suggested that this Management Plan be left in a draft format until that "Soils Report" is finalised and then based on that report this management plan should be reviewed to ensure it incorporates all of the relevant findings.

5.3 Removing the Sediment

Removing the 1,000,000 m3 of accumulated silt will be difficult, based on the observations that the Lake when drawn down is reverting back to its natural spring "Swampy Plain" nature. As such removal of much of the accumulated sediment would have to be wet dredged, at a higher cost, with a probable $20 Million plus price tag. This equates to a residential contribution of around $1500 per property.

If the sediment build up continues with time then the lake will eventually be lost as a recreation lake and will move into the wetlands category. After a further period of time the wetland will become playing fields with a large channel through them. The latter simply translates into the loss of the flood mitigation role and 20,000 – 50,000 m3 of sediment now being transported through to the Murrumbidgee River each year.

Given the importance of the Murrumbidgee River to the Murray Darling System then potentially a starting place for any project to reduce the amount of sediment is to start by approaching bodies such as the Murray Darling Commission and see if there are any funds that may be available towards removing some of the sediment from the Lake. Similarly there may have been some innovated work done elsewhere in relation to this. The relevant Departments for Recreation and Environment may also need to be approached.

A second sediment alternative is for Council to call for expressions of interest from persons wanting clean fill when the lake is at a low level. Council can then from the dry edges remove the sediment requested and have it available to those carters that attend the site at no cost. This reduces the costs to Council to remove sediment from the Lake without hopefully having to stockpile soils at the Lakes edge for long periods of time. Possibly there may be funding from other bodies towards these self help activities.

A final alternative is to do nothing and allow the Lake to take its natural course which is mapped out above. However this needs to be a conscious decision with all parties understanding in detail what the loss of the flood mitigation protection may mean for the city, as well as the loss of the recreational capacity.

5.4 Deepening the Lake

Following on from the removal of sediment is the concept of deepening the lake or even just deep channels in the centre of the Lake to allow say water skiing. As with Section 5.2 the major factor here will be cost involved. Deepening the Lake a further 1 m will see the price tag for this deepening plus sediment removal rise to around $35 Million and the cost will not be much less just for a deep channel to be cut along the length of the Lake as this would be in that wet area that requires dredging. The other potential difficulty for a deep channel is the mobility of the sediment with a reasonable expectation that the channel will become filled with this sediment within a period as short as five to ten years depending upon when more inflows into the Lake will occur.

At a cost of around $2,500 per property it is unlikely that this option will be pursued during the course of this Management Plan.

In addition to the above it would be argued that much more needs to be understood about the interrelationship between the Lake and the groundwater table before proceeding with this option or any deep channels. It is possible that any dredging or deepening could either destroy this interrelationship or even potentially lead to a greater salinity input into the Lake. There will need to be a detailed profile established for the Lake before any deepening can occur and this will be an expensive exercise.

5.5 Creation of an Island

Construction of an island in the Lake has been seen as both a clever way of getting rid of some of the sediment and of creating a safe habitat for some birds. Whilst these are amiable targets this option has several negatives that also attach to this proposal. These are:

- The sediment has no wet bearing strength and to hold it into an island will require an expensive concrete or wooden shell be constructed to support the sediment. Possibly if sufficient sediment were pile so that the top surface was dry it may become more stable but there would be some concerns that under different erosion impacts most of the sediment would gradually return to the base of the Lake.

  Adding fill from another site into a lake that is choking from the accumulation of sediment seems totally inappropriate, as well as very expensive.

- The island will most probably create wave problems for the skiers who use the Lake.
- The Boat owners when contacted previously indicated a belief that the Lake was too small for the incorporation of an island.

Based on the above, this Management Plan does not support the construction of an island at this time until a much larger number of the other issues can be resolved and a more detailed study on the practicalities of this option has been conducted.

5.6 Raising the Top Water Level of the Lake

Alternative to digging out the bottom of the Lake is the concept of raising the top water level of the Lake. By implication this will lead to raising the level of the Lake Albert Road.

This option will be governed by:

- Wind generated wave action and where they may reach through a raised top water level.
- Flood levels that will attach to the raised top water level.
- Any properties that will be impacted from the above just the raised levels

A brief study of topographical maps indicates that there will be limited opportunity to pursue this option. If the option were to be pursued it could have a price tag of between $1 -$2 Million but without understanding exactly what is required there are large components of guess in that estimate.

It is suggested that during the life of this Management Plan there be sufficient survey work carried out to better quantify just what is possible under this option but this is not seen as one of the priority issues to commence this management plan.

5.7 Removing Snags and Navigable Hazards

NSW Maritime have indicated that the old depth requirements for when boating can occur on the Lake have now been replaced by the individual boat master making the decision in relation to they can safely use the Lake. Thus the cleaning of the base for navigable hazards to boating such as tree stumps is an activity that should be undertaken and potentially this may be best achieved as a community activity supported by Council.

It is suggested that whilst the top water level is low, this activity should be undertaken and possibly it should be co-ordinated between the service clubs, WAUG or the Boat Club or some combination of the above.

5.8 Conclusions and Recommendations to Alternative Capacity Options

Preliminary analysis reveals that the costs to deepen the Lake are too prohibitive to contemplate and similarly there seems to be little benefit in trying to raise the height of the Lake at this time. Rather this section recommends that:

1 That Council explore with those bodies responsible for the Murray Darling Basin if any assistance may be possible in removing sediment from the Lake to better protect the Murrumbidgee River.

2 That Council call for expression of interest from business and private residents for the sediment from the Lake and then extract it and provide it to these body as part of the sediment control measures it is adopting. If successful this process should be repeated in subsequent years when the Lake's top water level is significantly reduced to give access to further sedimentation. The first such application will be a trial of what can be achieved. Council could use some of this material for landfill and to fill in the sludge lagoons at the augmented STPs once they have been clean out, as they will no longer be required in the new treatment plants.

3 That a community based activity be launched to clean up the base of Lake Albert possible as part of the "Clean up Australia" initiatives.

4 Sufficient survey work be carried out to be able to understand the extent of any possible raising of the top water level of the Lake for the next management plan. By then the more preferred stormwater options will have been explored and if unsuccessful this raising the height can be revisited, if the survey indicates it to be more viable.

Figure 5.1

Lake Albert Road at Overflow of Lake

6.0 PERFORMANCE OF THE LAKE

The overall performance of the Lake can arguably be best judged from several different perspectives, each effectively reflecting one of the multiple roles played by the Lake. However in so doing, it also needs to be recognised that the term “lake” is used to describe not just the body of water, but also includes the foreshore areas and the significant community assets associated with the same. Thus this performance evaluation needs to briefly include:

1 The general availability of the Lake to the community for recreational purposes. Reduced top water levels translate into the Lake being unavailable for water skiing, sailing, fishing and other water sports. It has also resulted in the no water being available for the irrigation of the golf course and the course has suffered some damage as a result.

2 The number of blue green algae blooms (or any other contaminants) that will result in the short term closure of the Lake, and its general unavailability to the “on water” users would be seen as a failure in the performance of the Lake, against the original decision to develop the Lake as a recreational facility.

3 Its overall suitability for the proposed recreational uses it is intended to provide. This will be determined predominantly from its overall usage and community views of the Lake. Section 3 clearly indicates that the community are big users of the Lake, but are not happy with the loss of water from the Lake in recent years.

4 The ongoing accumulation of sediment that has been eroded from the catchment, as this has the potential to reduce the life of the Lake, if the accumulation is not controlled.

5 Variations in surface levels of the Lake during more normal periods of rainfall and how these will impact its ongoing usage, particularly when paired with the effects of the accumulating sediment.

6 The ability to develop the surrounds of the Lake into strongly used community facilities, recognising that the Lake already has a number of such facilities that are well used and additional facilities are already being added to these.

7 The ability to maintain the Lake as an effective fish habitat.

8 The performance of the Lake as a flood mitigation mechanism.

9 Problems emanating from the Lake such as odours, noxious weeds, inappropriate bird or animal life.

10 Is the Lake achieving anywhere near its full potential?

6.1 2001 - 2009 Performance

In rating or scoring the performance of the Lake, then the period 2001 -2009 forms the initial starting point, for this Management Plan, as based on historical records, it seems to set the benchmark. For example reference to Table A2, demonstrates that the Lake has, during this period, undergone the longest continuous time of below average rainfall, in the period of records that tracks back till 1942. 2001 – 2009 also

includes 3 of the seven driest years on record, with 2009 only 3.3 mm of rainfall above the driest year in this record period (1967) as at the end of June. Possibly this period is demonstrating the impacts climate change that the operation of the Lake will need to be adjusted to. Alternatively it may just be that Wagga Wagga is in the grips of the worst drought on record, with some pundits suggesting that this dry period represents a 1 in 1000 year event.

	Criteria	**Score**
1	Sufficient water for recreational activities	Significant failure
2	Blue green algae blooms shutting Lake	Only partially relevant here. There have been some but the Lake is too low anyway and already shut
3	Community Satisfaction	Poor based on the Council Survey
4	Accumulation of Sediment	Much improved performance during the 2001 -2009 period, as the lack of inflow has lead to little sediment flowing in. Over the longer term however the Lake is failing even with this period a brief respite
5	Variations in Surface Level	Irrelevant as the lake has been too low to be meaningful
6	Surrounds for Community Usage	Lake is still well used for a number of non water based applications but community seem to want more foreshore development based on survey results
7	Maintenance of Lake as Fish Habitat	Poor with little restocking possible but some misunderstanding may allow future opportunities
8	Ability of Lake as a Flood Mitigation Structure	Excellent the Lake has the capacity to clip 3,000 ML off any flood that may occur in the short term
9	Problems occurring from the Lake	Some weed growth is occurring at the edges, sediment has no bearing strength when saturated
10	Lake Potential	There appears to be no real plan to judge the Lake against this criterion
	Overall Grade as Recreational Water Body	**Failing**

Table 6.1

Scorecard for 2001 - 2009

Table 6.1 represents the performance scorecard that corresponds to this period, rating the Lake against the objectives listed above. As a general overview the Lake

is effectively receiving a failing grade, in all of the categories, except flood mitigation and sediment accumulation during this 2001 -2009 period. The good results in these categories simply being attributed to the lack of inflow in this period and as such these criteria represent the only silver lining that can be attributed to this period. The table also reveals how many conflicting issues are involved in the management of an inland Lake.

Lake levels for recreational activities are a function of an inflow and outflow equalisation process, with a greater inflow than outflow as the only real formula that will retain the Lake available for recreation purposes. Depth in the Lake provides a factor of safety for short term accidences when outflow (evaporation) is greater than inflow. However when outflow exceed inflow for protracted periods then this factor of safety can be lost in as short a period as 18 months under extreme (drought) conditions. Other less severe dry conditions should provide 2 to 3 years of safety.

Section 4.0 of this Management Plan along with Table A4, have clearly documented the failure of the filling mechanisms for the Lake, during the period 2001 – 2009. That table and some of the irregularities contained within it have suggested the need to better understand what is happening in the Catchment. This plan supports that action but also recognises that there is a similar need to better understand the Lake's empting mechanisms. This review should also determine if these mechanisms can be modified in some way to contribute to the retention of water in the Lake and hence the availability of the recreational capabilities.

From this scorecard, issues such as community satisfaction and the desired foreshore amenities, as well as the Lakes ongoing potential have effectively been dealt with under Section 3.0 of this Management Plan and are not repeated in the following sections. Issues of maintaining the lake as a viable fish habitat have also been dealt with in Section 4.4. and Blue Green Algae is effectively dealt with in Section 8. This therefore leaves the following as issues that require greater exploration in the following sections:

- The mechanisms for the emptying of the Lake
- Sediment accumulation
- Flood mitigation
- Problems arising from the Lake
- Variations in the surface levels of the Lake.

6.2 Mechanisms for the Emptying of the Lake

The Lake's primary mechanisms for emptying are

- Evaporation
- Water Used for Irrigation
- Groundwater
- Overflowing the Lake

From community feedback during the preparation of this Management Plan there appears to be considerable misunderstanding in the community of the roles played by each of these factors, in the emptying of the Lake. Table 6.1 briefly summarises the real impacts of these differing mechanisms, and this understanding is essential in

any Lake Albert, Management Plan. In this manner, any efforts to retain the Lake's top water level, are then best focussed in those areas of maximum return.

Table 6.2 clearly identifies that evaporation dominates the loss of water from the Lake, with the relationship with groundwater not able to be determined with any confidence at this time, and overflow a function of the nature of the rainfall that occurs. The golf course and the other minor extractors are considered to be the smallest of the extraction mechanisms with the volumes involved considered to be negligible.

Causal Factor	**Potential Changes to Top Water Level of the Lake (Drop in Level)**			
	Drought Year	**Moderately Dry Year**	**Average Rainfall Year**	**Wet Year**
Evaporation	1000 -1800 mm (see note 3)	700 to 1200 mm	0 to 700 mm (see note 4)	Lake likely to overflow (see note 5)
Water Loses to Groundwater	(+) Expected Groundwater Inflow	Possibly nil impact to some inflow	Up to 200 mm (see note 6)	Up to 400 mm (see note 6)
Overflows	Nil	Nil (see note 6)	Up to +500 mm (Up to 2,000 ML)	Up to +2000 mm (Up to 5,000 ML)
Losses to the Golf Course	18mm (16mm)	15 mm (12mm)	12mm (2mm)	(+4) mm (see note 7)
Other Minor Extractions	3mm	2mm	1mm	Nil

Table 6.2

Likely Impacts on Main Factors Emptying the Lake

Notes:

1 *A drought year is defined as rainfall of around 300 mm, a moderately dry year has around 450 mm (80% of an average year rainfall year) an average rainfall year as being 566 mm of rain and a wet year is defined as up to 700 mm per annum.*

2 *A (+) symbol appearing in the table denotes an increase in the Lake's top water levels, as a result of particular circumstance with this causal factor whilst other figures to represent fall in the Lake*

3 *The rainfall records that are set out in Attachment No 1 show in general the actual performance occurring across a range and considerable interpolation is required. For example the 1000 to 1800mm in a severe drought year will occur because there will be no significant inflow into the Lake. Evaporation in this period will exceed 2.0 m and thus when the Lake is near maximum top water levels the total evaporation could result in losses as high as 1600 - 1800 mm.*

However if the Lake is already drawn down then evaporation rates will be reduced.

4 *The Lake should fill in an average rainfall year but even then there can be reasonable change in the top water level from time to time as set out in section 6.3.*

5 *During wet years the evaporation losses will effectively be offset by the large volumes of inflow that could and probable will result in an overflow of the lake. It is possible however for the Lake to still be down at the end of the year if there has been an extremely wet start to the year followed by a drier than average second half of the year. Hence it is possible that depending on the rainfall pattern that in such a year measured at say the end of December that the Lake could in fact be down 0.5 m on its top water level. Clearly annual rainfall is a poor guide and much more need to be done to better understand evaporation losses under all conditions.*

6 *Too little is known in respect to the Lake's interrelationship with groundwater and the figures included in the Table are simply an engineering guess, without scientific foundation. Refer Section 6.2.2.*

7 *The Golf Course will also be a contributor of water to the Lake with a manicured sloping surface and the considerable amount of hardstand area it is estimated that in an average rainfall year the course potentially contributes 80 -100 ML to the Lake, depending upon actual rainfall patterns. Hence in wet years the Golf Course may be actually an overall contributor of water to the Lake rather than an extractor. If this parameter was measure as part of the actual water footprint then the overall impacts over the four different rainfall years as shown in the Table would amend to (16 mm; 12mm; 2mm, +4mm). These figures are however only guesstimates.*

Figure 6.1

Lake Reduced to a Level where Boating Prohibited

It is appropriate to now review each of these emptying mechanisms in greater detail, before moving to those other factors that impact the Lake's performance.

6.2.1 Evaporation

Typically pan evaporation at Lake Albert in an average rainfall year is of the order of 1.5 m per annum with approximately 0.9 m of that that evaporation occurring in the four months of November to February each year. Evaporation will be higher than this in most drought years and reduced in wet years.

Translating that evaporation into a moving top water level for the Lake is offset by:

- Rain falling directly onto the Lake.
- Run off from rainfall in the catchment immediately surrounding the Lake, including the Tatton Drain Diversion.
- Inflow into the lake from the two main creeks that drain the overall rural catchment. These do not always flow and have not flowed often in recent years (refer to the filling of the Lake, Section 5 of this report).
- The impacts of the other factors identified in Table 6.2

Given the Lake has a top water level of 191.5 (AHD) then a simplistic formula to determine the likely top water level of the Lake at any time is 191.5 – (evaporation plus other loss factors for the period since the Lake was last full) + (inflows for the same period of time). However the actual or real calculation is much more complex and requires further understanding of the specific evaporation factors at Lake Albert.

Whilst evaporation for January can be as high as 15-20 mm in one day, evaporation is not just a matter of the latent heat that occurs in that month, rather it is also interrelated to the amount of wind blowing on the day. Evaporation due to heat alone can in this way be increased by three of four times by wind action. As the Lake deepens, evaporation decreases not just because the surface area decreases, but also as the top water level decreases it makes it harder for the wind to have its maximum possible impact on the Lake. This appears to be the case, with top water levels slowing down their rate of decrease, based upon the few observations that Council has of the top water level of the Lake, over time. Groundwater inflows may impact and complicate these observations.

Hence whilst the pan evaporation figures give a lose guide to what is happening in the Lake they need to be replaced with real day by day monitoring of the Lake. This has already been discussed in Section 4.1 but because there is also a need to relate the inflow data with evaporation details, Table 6.3 sets out what should be recorded, based upon daily readings. In this manner Council will then be able to more accurately gain a true understanding of:

- Real evaporation losses
- Inflows and when they occur

- The Interrelationship of evaporation with potential groundwater inflows

This part of the Management Plan therefore reinforces previous recommendations that an automatic system be set up to monitor the top water level of the lake on a daily basis, and then relate it to both the evaporation and the inflows. Longer term analysis of the Lake when it is drawn down will allow some conclusions to be derived in relation to the impacts of groundwater on what is occurring and the next management plan should be in a position to suggest some basic quantification of this interaction.

Date	TWL AHD (m)	TWL Variation mm	Temp (C^o)	Wind Speed and Direction	Rainfall (mm)

Table 6.3

Suggested Reporting Format for Daily Lake Information

Another factor for consideration under evaporation is to understand the impact of trees by the water's edge. Apart from some small value in shading the water at the edges of the Lake, the main impact of these is that a good tree screen helps to reduce the role of the wind in evaporation, for large standing bodies of water.

It is understood that under the tree planting components of the Lake's landscaping some 300 trees have already been planted. It is therefore suggested that latter in the period covered by the Management Plan (when the growth of the trees can be seen), that the tree screen is reviewed and checked against the desire to set up an effective wind screen. This overlaps with the information from the daily monitoring of Lake levels, as this may indicate the tree screen is less needed that suggested, but this is doubted.

It is also suggested that community comments be sought on the adequacy of that screen as effective cover for recreation areas is becoming increasingly important to those that wish to use outdoor facilities. It is suggested that this question should appear in future questionnaires.

6.2.2 Water Losses to Groundwater

It needs to be remembered that before a decision was made to change the previous "swampy plain" into a recreational water Lake in 1898, the body of water was identified as a reliable water spring in historical records of the region. Hence it could be logically concluded that the Lake has evaporated back to its older role.

In early 2005, evaporation calculations indicated that the Lake should have been totally dry, but it always seems to retain about 0.7 metres of water in it along with a lot of sediment. Section 4.4 has suggested that the Lake Is unlikely to totally dry out in drought, rather we have a return to “Swampy Plain” type conditions.

It will require considerably more study to determine if this spring is constantly recharging the Lake, albeit slowly, or if when the Lake is full, it is recharging the aquifer that the spring comes from. The recording of top water level data and the other information will provide some insights into just what role groundwater is playing in the Lake’s composition. Once sufficient data has been collected, some form of study and analysis can be carried out in relation to this groundwater.

6.2.3 Overflows

It has been recognised in the Lake filling section of this Management Plan (Section 4.0) that it does not require an average or wet year to fill the Lake, to a point of overflowing. Four consecutive months of above average rainfall in 2005 seem to have achieved this and only a guess can be made at what the volumes were lost from the Lake in this process. This rainfall however did occur during those months of the year with the minimum evaporation.

Again the adoption of an automated measure of Lake top water levels may allow something more than wild guesses as to how much has been lost and potentially this may also allow for some raising of the Lake top water level, to be explored further in the next management plan.

6.2.4 Golf Course

The Golf course is allowed access to water when the water is above a fixed level, reducing down to zero when a second fixed level is reached with restricted volumes at differing levels in between. Given the golf course irrigation water represents such a small amount of the water removed from the Lake (typically about 150 ML/annum) it is suggested that the Golf Course become an issue for further discussion at the first management meeting of the Lake. When the runoff contributions from the manicured turf surface and club buildings are factored into the water equations for the Lake, then it becomes obvious that the overall water footprint for the golf club is very small.

It is logical in the first instance to explore effluent reuse for the Club as an ideal mechanism for turf irrigation. However if this does not turn out to be economically viable then it is suggested that consideration be given to removing the current withdrawal conditions, to allow the club more reasonable access to the water in the Lake. Such assess may still be limited to reflect the drought conditions.

The Tatton Diversion would be returning more water to the Lake than the course is removing, even in drought years, hence it will offset any golf course usage.

6.3 Changes to the Top Water Level

Good rainfall will undoubtable see the top water level of the Lake higher and closer to the maximum water level before overflow but even in these wetter years, it needs to be understood that the actual top water level will still fluctuate from time to time. This represents the cyclical nature of the seasons, particularly the high evaporation of the summer months.

It is possible to have movements of up to 1.0 m in top water level due to dry hot summers and little rainfall. This aspect will become critical with the ongoing accumulation of sediment into the Lake as the factor of safety (depth to the top of sediment) is reduced.

The dry conditions may also have only small surface movements due to the fact that the Lake is already well drawn down, and actual reductions are becoming more complicated by groundwater re-entering the Lake. Table 6.2 also provides some guide as to these possible changes in surface levels.

6.4 Sediment Accumulation

The differing NSW Soil and Catchment Management services have recorded the Lake Albert Catchment has historically been extremely active in terms of erosion and as such capable of producing a significant amount of mobile sediment that will head for the Lake. Historically the Lake was spare much of this sediment transport as the initial diversions were partial in nature but since 69/70 when the Crooked Creek was totally diverted this silt has been accumulating in the Lake at an accelerated rate. This is further accelerated by the connection of Stringybark Creek in 1977, but that diversion does have a silt trap on it. The Crooked Creek diversion has no diversion on it making it a much different proposition.

A 1985 Soils Conservation Study of Lake Albert, records the following in terms of sediment accumulation in the Lake:

- The average depth of recent sediment was of the order of 0.65 m which equates approximately to around 800,000 m^3 of silt or sediment.
- In the period 1970 -1985 the average rate of sediment entry to the Lake was around 53,000 m^3/ annum. However substantiative stabilisation work in the catchments has now reduced this figure to an estimated 20,000 m^3 per annum and if there is a silver lining that can be drawn from the dry 2001 to 2009 period it is that there will have been limited sediment transport in that time period
- It is probably that the volume of accumulated sediment as at 2009 is of the order of 1,000,000m3 with the average depth of silt accumulation varying between 0.9 m and 1.0 m. The sediment appears to be quite mobile and distributed reasonably equitably throughout the Lake with arguably the greatest depths of silt nearest the entry of Crooked Creek.

The presence of the Lake has spared the Murrumbidgee River system (and by implication the Murray Darling) over 1,000,000 m^3 of sediment transport, and possibly some funding for sediment removal may be able to be achieved from those sources.

The bottom line however in relation to the long term role of the Lake is that the accumulation of sediment will continue until it reaches a stage where it is no longer

safe to use the Lake for active recreation such as boating or swimming. As such the Lake will become a wetland for a long period of time, and then progressively this will raise itself above the top water levels and the Lake will become playing fields or agricultural areas, with a deep channel through them that will:

- Increase the potential for downstream flooding in Wagga and possibly put further strain on the levee banks that protect against significant flow from that source.
- Resume the transfer of the sediment to the Murrumbidgee River.

Thus reducing the amount of sediment accumulated in the Lake and slowing the inflow rates become priority activities for Council, within the life of this Management Plan. The observations from the Soil Conservation report of 1985 would indicate that if sediment continues to accrue at 20,000 m3 per annum then the depth of the sediment will rise by around 200 mm every 10 years or so. At this rate then by 2030 onwards then, with the summer evaporation losses, boating may become restricted on a regular basis, during the boating season.

These dates can be put back to at least 2050 by:

- Reducing the volume of sediment gaining access to the Lake, each year.
- Removing some of the accumulated sediment generally on an opportunity basis.

Stringybark Creek is equipped with a sediment trap, but Crooked Creek has no such sediment trapping mechanisms and there has been considerable amount of sediment that has been accumulated near the mouth of that Creek that can be cleared at any time. Council has a preliminary estimate for a full pollution control pond to be fitted to that water source and those costs are understood to be of the order of $1M, which may push out the period till Council can accommodate the full pollution control pond within its budget. However there are a number of smaller sediment collection measures that could be adopted in the interim for only a small fraction of the costs of this larger Pollution Control Mechanism. It is therefore suggested that the infrastructure division design and construct a series of sediment control measures in Crooked Creek, as a means of reducing the volumes of sediment entering the Lake.

Working closely with Soil Conservation in the catchment can further reduce active erosion as will finding better mechanisms to reduce the volumes or erodible material in the creek beds. Some of these solutions however may result in some more trapping of water in the catchment but potentially some better compromise may be able to be reached. It is further anticipated that several recommendations in respect to these matter will result from the Catchment Study suggested in Section 4 of this study. Most of these issues will be dealt with through that study.

Discussions at officer level with Soil Conservation Officers have also indicated that the sediment from Stringybark Creek can remain in suspension for some time making it harder to remove in the sediment traps. Indeed it would seem that any review in relation to wetlands and other sediment control structures in the Lake Albert area will need to reference that document before they can be completed.

6.5 Flood Mitigation

A completely opposite role for the Lake is that of flood mitigation, that simply translates into the fact that the emptier the Lake, the greater its ability to mitigate any potential flooding that may emerge from the Catchment. Indeed converting the Lake into a slow release retention pond has considerable merit in the case of a flood.

Figure 6.2

Overflow from the Lake Down the Tatton Drain

Whilst empting the Lake is almost at complete odds with everything that is contained elsewhere in this Management Plan there is a need to explore factors such as the ability to draw down the Lake early, if alarming rainfall is predicted. The impacts of any flood that may be produced in the catchment can in this manner be somewhat mitigated through the use of the Lake. Similar considerations apply to the Tatton drain arrangements and any other stormwater diversion structure that may be constructed with a strict usage protocol applying to these and interrelating to the SES, to fit in with their overall flood management.

As such Wagga Wagga City Council needs to develop localise Flood Management /Mitigation plans around Lake Albert and exercise these with the other relevant NSW agencies. This action needs to be carried out during the life of this Management Plan, including the getting the sign off from all of the other agencies, for the flood management procedures.

6.6 Problems Arising from the Lake

This Management Plan has focussed on the more immediate threats to the lake in terms of the lack of water, the impacts of silt accumulation, the need for better data, and the need for a more co-ordinated approach. However it is hoped that future plans

will find more scope to address the more unique problems that associate with the Lake. These include issues such as:

- Wave actions and potential erosion of the foreshores, as well the impacts of wave action back on skiers.
- Co-ordination of recreational activities and the potential need for an operational charter for users of the Lake. Further to this may be the need for the creation of a recreational manager for the Lake.
- Weed growth with improved water quality and in particular when the Lake is drawn down.
- Coordinating community events for the improvement of the Lake.
- Understanding the risks involved with the sediment in the Lake in that it has no bearing strength when saturated and anyone trying to wade across the Lake could get themselves into trouble. Potentially signs need to be erected to warn residents in relation to this matter although there does not seen to have been historically recorded in relation to this manner.
- There are a number of research projects applicable to the Lake that need to be defined and carried out , potentially with bodies such as Charles Sturt University. The potential for this can be explored during the life of this Management Plan with more definitive directions spelt out in the next Plan.

It is suggested that a register of Lake issues be created and that issues arising through general correspondence, feedback in the forums of reporting back to the community on the Plan, or any other mechanism that may arise be recorded in the register. The register thereafter becomes a key input into future Lake Management Plans.

6.7 Future Directions

Much of this Management Plan is directed at better understanding more about the Lake and the Catchment, including investigating those more promising alternatives to fill the Lake or support its recreational functions. Most of this information is required because Council and the community will need to clearly decide what is to happen in relation to the Lake. For example:

- Should the Lake be retained as a perpetual recreational water body including all of the same functions it currently has, irrespective of the costs involved?
- Should every reasonable effort be made to ensure the Lake can be retained as a full recreational Lake until 2050, when decisions can be reviewed because other facilities may have been developed? Alternatively usage of the Lake from a boating perspective may have dropped off to such an extent that it will be hard to justify retaining the Lake in that format, beyond that date.
- Should the Lake just be allowed to become a natural waterway in due course with the community taking advantage of any recreational activity until that date comes?

- Should some other alternative be reached in between these distinct positions?

Retaining the Lake as a recreational water body till 2050 is quite achievable, but still requires that some targets be set within this Management Plan to at least have all of the Lake management bodies moving in the same direction, before the decisions on the Lake's future directions are finalised. For example reducing the sediment to say 10,000 m^3 per annum will have the rate of accumulation of sediment and give the lake another 20-30 years alone. If some sediment can be economically removed then this also adds to this life extension, as does supplemental filling of the Lake. A listing of the suggested targets is set out in the executive summary for this Management Plan.

It is suggested that these long term decisions be deferred until the next Management Plan, but if the community feels that it needs a little longer to make those decisions, then this Management Plan would urge that the community work towards the option of retaining the Lake as a full recreational Lake until 2050. As stated this is achievable without great impost on the community.

6.8 Conclusions and Recommendations in Relation to the Performance of the Lake

The performance of the Lake in recent years could only be described as poor as it has been unavailable to sections of the community in the manner in which they seem to want to use it. This reduced performance has caused some financial hardship to those directly involved with the Lake. Whilst the period 2001 -2009 is something of an abhoration in terms of rainfall, it cannot simply be tagged as such in the hope of improved performance into the future.

Unfortunately climate change, the fact that the real emptying mechanism is evaporation and the ongoing accumulation of sediment will transform the long term or normal performance of the Lake, into something that is more akin to the 2001 -2009 period. Conscious decision needs to be made by the entire community when all of the facts have been gathered as to what will be the long term role of the Lake. In the interim this management plan recommends that the Community move in those directions that are about maintaining the Lake as a full recreational Lake until 2050 as this is seen as a reasonable precautionary position that maintains the facility without seeking unreasonable imposts be place on the community through Council. This position allows the community the time required to make the decisions it must in relation to the Lake.

As part of that information gathering exercise this section of the Management Plan also makes the following recommendations.

- Construct a series of sediment traps along the Crooked Creek diversion in an effort to reduce the volumes of sediment flowing into the Lake.
- Have an individual Flood Management Plan prepare for the Lake Albert area, and build some of the proposed procedures to reduce the Lake levels if required into future Lake Management Plans.
- Create a specific problems register for the Lake and progressively work through those issues.

- Explore the use of effluent to irrigate the Wagga Wagga City Golf Course and if unsuccessful seek to have the current irrigation requirements reviewed.
- Include evaporation wind speeds and temperature along with lake top water levels

7.0 MANAGEMENT OF THE LAKE

7.1 The Need for a Management Committee

Lake Albert has evolved through a series of Community, Local and State Government initiatives, but its overall management occurs through a number of different governmental agencies, who whilst they cooperate on an "as required basis", effectively work independent of each other and as such no formal management committee exists for the Lake. Each of the Agencies/ Departments takes responsibility, for some specific aspect of the Lake's operations based upon their Departmental portfolio.

At a day to day operational level, the Lake also supports a diverse (and often conflicting) number of user groups. Most of these groups have tended to operate through a number of organisations. In 2004/2005 the Wagga Aquatic User Group seemed to have the front running whilst the Boat Club seems to be more at the forefront in 2008/2009.

Both sets of arrangements appear to have worked relatively well, irrespective of the informal nature of the arrangements. However the question that arises in moving on with the Lake is, will these informal arrangements continue to suffice for all parties, particularly when it has already been recognised the nature of the Lake could change in what is a relatively short time frame. In addition to this basic change of the Lake, there will also be:

- Increased regulation for all recreational waterways, ranging from water quality to how the water body is to be used. As such there will be greater "duty of care" requirements placed upon Lake Managers to ensure they get it right and that there is minimal risk to the community.
- Rising general litigation in the wider community, right across the board and this partially overlaps with the regulation listed above. Authorities can no longer simply provide a facility and expect the community to use it appropriately. Indeed Authorities need to anticipate how it may be potentially misused, and if they have not done so, can be potentially held responsible.

Given all of the above, it is suggested that Council and the other bodies responsible for the Management of Lake Albert need to move to the adoption of a more formal Management Committee for the Lake to improve and drive the overall management of the Lake. The committee is not meant to hold specific power, but rather be a communication and coordination body that allows each of the organisations to still exercise their organisational responsibility but in a more informed manner than arguable has occurred previously.

7.2 Suggested Membership of the Management Committee

The following are suggested as initial members of the committee

- Wagga Wagga City Council
- NSW Department of Health (through the Local Southern Area Health Service)

- Department of Environment, Climate Change and Water
- Murrumbidgee Catchment Management Authority
- Department of Natural Resources (Predominantly the Fisheries Division but may be overlap with Agriculture)
- NSW Maritime
- Department of Lands
- Other as appropriate.

The above list is not meant to be definitive, rather as a starting point and further membership is a key issue that can be pursued at the first meeting of the committee so that no organisation is inadvertently overlooked.

Community membership is seen as desirable but how that is achieved should be a matter for the new management committee along with the time scale for this. A draft agenda for that first meeting which may need to be broken down into two meetings to allow the committee to get through the work is a matter to be contemplated after the committee has formed.

Figure 7.1

Part of the Diverse Catchment of Lake Albert

7.3 Committee Members

The actual individual to represent the suggested member organisation will be a matter for the various agencies to decide and in some instances there may be more than one division/ department of an organisation that takes an active role with Lake

Albert, hence that organisation may want more then one individual to be associated with the new committee.

It is also intended that this be an operational group hence the membership should comprise operational managers not policy advisors, as most meetings will be about operational detail.

It is therefore recommended that Council write to the agencies listed in Section 7.2 asking:

- If they were interested in being apart of the Management Committee being charged with the responsibility for Lake Albert.
- If the answer to the above was yes, then seek from organising the name, title and normal roles of the individual proposed.
- Full contact information for the individual(s) nominated.
- Have the Council chair of the initial committee write to that individual and set up the initial committee meeting

7.4 Administration of the Committee

As Council currently takes the day to day operational responsibility for the Lake it is suggested that they should chair this committee and with that they should take the secretariat responsibility as well. This arrangement however can be discussed at the first of these meetings and alternative arrangements established as appropriate if required.

Council needs to determine who this chair is and they will need to have sufficient operational and technical background to work with the likely representatives, from the other Government departments.

It is intended that the committee meet at least once each year and maximise the out of session communication between the set meetings. However there may be some value in meeting more frequently in the initial establishment of the committee given the size of the agenda items as set out in Attachment No 4.

All committee members should have the right to request a meeting if there is an item of need that cannot wait and just cannot be dealt with out of session

7.5 Out of Session Communication between Committee Members

It is initially intended that the Committee establishing a quarterly report by exception, even if that report contains little more than:

- Top water levels in the Lake from the new monitoring arrangement
- Water quality data
- Progress against any joint initiative

It is hoped that this initially set communication leads to a free flow of information that to some degree overcomes the need for this formalised quarterly report but it is suggested that until the committee reaches that stage that a formal report be adopted as a discipline on the committee to get the members to communicate better.

7.6 Conclusions and Recommendation Arising from the Management of the Lake

The former ad hoc or independent arrangements between all of the agencies with management responsibilities for Lake Albert need to be supplemented with a formal management committee that ensures close ongoing communication whilst not interfering with stipulated organisational roles. It is therefore recommended that Council take the lead on this issue and write to a number of relevant agencies seeking their interest to participate in such a committee. It is also recommended that the first such meeting should be targeted at being held in November 2009.

Figure 7.2

Typical Foreshore Area

8.0 MONITORING THE LAKE

In the management of Lake Albert, Council follows the NHMRC and ANZECC guidelines for the management of recreational waterways. Overall the management of recreational water bodies is based on a risk management approach. To use the guidelines therefore requires some definition of the risks to the Lake Albert water quality and to determine what these risks are and how to manage Lake Albert in response, there is first a need (in general terms) for Council and the NSW Department of Health understand the following:

- Just how the Lake is impacted by rainfall, both in the short term and in the longer terms (as it would appear this is the one of the major water quality hazard for the Lake).
- Are there any particular poor water quality areas in the Lake, after these rainfall events, which require some more extensive testing than that being done for the general area of the Lake? Is the water quality worse coming from the urban stormwater drains or the Tatton Drain diversion and if so what does that mean for the Lake and its users. Based on preliminary feedback from Soils Conservation officers it may be that there is considerable difference in the water quality coming into the lake from the two major tributaries.

  Council needs to have a picture of what is likely to happen in such events in terms of determining if there is a likely pattern that may follow a particular event. However given the size o the Lake even just the reduced lake then obtaining such a picture will still be an expensive exercise.
- How much does the Lake improve or degredate water quality, given that Lake is shallow with excellent sunlight penetration (UV) and the motor boat activities are providing good aeration of the water, to further assist in any treatment of the water?
- How does water quality change in its passage down the Lake to the overflow point. If there are significant variations, it may be possible to redesign a particular water sports course, to fit in with this natural water quality variation.

To answer these questions the Lake needs to be monitored over time but more specifically for specific rainfall events and from the results of these tests, some guidance should be possible in terms of what could be expected to occur in the Lake and what the best way to practically manage the Lake. Is there for example a certain patter to water quality when the lake is filling , after it has filled when the top water levels are retreating, just filling from urban stormwater, etc. It may be that there is no pattern but if there is a pattern (and one is expected) then that needs to be well understood and agreed amongst all of the Lake's managers as discussed in section 7.0. Hence events based data and the collection of it will be critical and this is discussed further in section 8.4.

This monitoring program will be greatly assisted by the catchment study, the implementation of the propose water level indicator and the Soils Conservation study indicating the role some sediment may be playing. Council already does much of this monitoring and is working towards the goals espoused so some of the following

sections are somewhat superfluous but are included more for the completeness of the report, other than creating new tasks for Council.

8.1 NHMRC Guidelines for Recreational Waterways

Water quality guidelines are necessary to protect human health, during recreational activities such as swimming and boating and to preserve the aesthetic appeal of water bodies. In response the National Health and Medical Research Council of Australia has in 2005 released a set of guidelines for managing risks in recreational waterways and Council follows those guidelines in the operation of Lake Albert. The primary aim of the guidelines is to protect human health from any problems arising from these recreational waterways.

The NHMRC guidelines are not mandatory, rather "they have been developed as a tool for state and territory government to develop legislation and standards appropriate for local conditions and circumstances". The guidelines are however meant to provide a best practice, "hands on" practical approach, aimed at helping those organisations managing recreational water quality, with a sensible way forward. Where they differ from previous guidelines is that they advocate a preventative approach to the management of recreational water, focussing on assessing and managing hazards and hazardous events, within a risk-management framework. This preventative approach replaces the traditional reliance on a percentage compliance with counts of faecal indicators or algae to protect the quality of water (microbial or other).

Accordingly the management authorities should establish monitoring programs for evaluating existing hazards and any changes that may occur in the water body once the risks are well defined and this may require an initial intensive testing program to allow a maintenance type of monitoring program that may fit within the normal levels of monitoring recommended in the guidelines.

8.2 ANZECC Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

In 2000 the original ANZECC (1992) guidelines were reviewed to incorporate current scientific information. The 2000 ANZECC guidelines have an increased focus on ecological sustainable development ensuring they complement major policy initiatives and directions and consider a holistic approach to the management of aquatic systems. Monitoring the 'Health' of aquatic ecosystems has seen an increase in the use of biological indicators as the knowledge estuarine and coastal ecosystems has increased.

The guidelines are not mandatory standards more so the guidelines should be used as a framework for measuring and protecting water quality for the full range of existing environmental values. They incorporate detailed guidance on refining national and regional guidelines for site specific application.

The microbiological characteristics outlined in the recreational water guidelines chapter 5 are utilised by Council in monitoring the water quality of Lake Albert. Bacterial content is analysed through faecal coliform organisms and enterococci organisms. The ANZECC guidelines are applied to determine the recreational category for water contact.

8.3 Historical Water Quality

In recent years Council has moved to provide sewerage services to the rural residential areas surrounding the Lake, and from which it was always possible some septic systems many have overflowed into the Lake over time. Thus in terms of future water quality management, most of the pollutants entering the Lake in the future will come directly from the catchment, which includes both rural and urban segments.

Further works in the catchment (including more storm retention basins) will be one way to protect the water quality entering the Lake, as will be a rigorous program of cleaning all sediment traps including the new arrangements proposed for the Crooked Creek diversion. However further complicating this matter are the following historical observations made in relation to water quality:

- Improved clarity of the water has resulted in much greater weed growth around the edges of the Lake reducing the overall enjoyment of the amenity for the users of the lake. More turbid water would appear to reduce this weed growth.
- Improved water quality has also resulted in more frequent blue green algae outbreaks within the Lake itself.
- There have been no reports that have been drawn to Council's attention of water quality impacts on humans using the Lake. Whilst it understood that a number of minor problems may have occurred they have never been reported. It will therefore be difficult to get users to take on board new water quality restrictions under these circumstances because there is not a perceived need. Thus any management on water quality grounds needs to be well based in terms of data.

8.4 Primary Indicators for the Lake

Whilst the NHMRC guidelines require the monitoring of a number of parameters the key parameters that will govern the long term use of Lake Albert, will:

- Bacterial (faecal coliform)
- Blue Green Algae (cell levels)
- Nutrients as the prompters of Blue Green Algae outbreak

8.4.1 Bacterial Elements

Swimming in the Lake is generally restricted to triathlons, skiers who fall off their skies and sailors who come out of their boats. As such the bacterial components will be more critical in the period before a major event, where clearly poor water quality may impact that event.

The guidelines direct Council and the other managers of the Lake in terms of what needs to be done in terms of minimising risk here but this needs to be reviewed and also requires that a good understanding of how water quality may vary over the Lake itself. It may for example in the case of say a triathlon be safer if the swim location is altered if there is some bacterial

concerns in the area proposed. This criterion should be reviewed with all of the Lake Managers and determine what else needs to be done here

Figure 8.1

Example of Land Water Interface

8.4.2 Blue Green Algae

Blue green algae has historically been responsible for the closing of the Lake on more than one occasion. T may be that from the pictures of water quality specific catchments/ activities can be targeted to improve blue green performance. This parameter may be further reviewed once the event based data becomes more complete.

8.4.3 Nutrients

Clearly the inflows of N and particular P will govern the potential generation of blue green algae. Soils Conservation is in the process of addressing this issue in terms of the sediments that flow in from the different catchments

It is also quite possible that much of these nutrient levels may become bound up in the sedimentation layers and the removal of accumulated sediment may greatly assist with reducing blue green production. Indeed there are a

number of good potential areas of research that should be evolved as part of this project.

8.5 Event Based Water Quality Testing

Ultimately Council and the Managers of the lake would want to have the following:

- An effective assessment of the risk posed to the Lake by rainfall runoff from both the rural catchment and the urban catchment. The latter being particularly important if the preferred urban top up option is adopted.
- An agreed program of appropriate and practical responses to these identified risks, such as moving a particular event to a different location in the Lake or even closing the lake, if there are water quality concerns.
- An understanding of the real risks passed by blue green algae and an appropriate response protocol to these events that mirror the new guideline cell counts and the risks as now defined. This will include a toxicology history for the Lake to explore what has happened in any elevated cell count.
- Agreement over the contact levels for algae for all water sports in the Lake.
- An ongoing monitoring program that confirms all of the above and gives both management agencies the confidence to make key management decisions.

To get to this information requires that a significant amount of data be collected based upon events that happen in the Lake rather than period based testing when tests are carried out at the same time each week, month or whatever. It is suggested that the monitoring of the Lake become an issue raised at the management committee and that the program be reviewed to determine the most cost effective way of meeting the needs of all of the Lake's managers as well creating these "pictures" of water quality performance.

However to gain this picture then water samples will also need t be taken from the centre of the lake rather than just the edges and to this end Council will need to secure some form of boat access for its sampling officers. Whilst access to a motorised boat would be preferable for when the Lake is closer to its full heights potentially some form of canoe may offer a better solution when the Lake is as drawn down as what it is at the time of preparing this report.

8.6 Conclusions and Recommendations in Respect to Monitoring

It has been identified that what is required of the monitoring program is to construct a picture of what happens to water quality in the Lake when it is dry and what happens when it is filling, just after it is filling and in the period well after it has filled. Indeed what each of the two major contributory sources are doing to that water quality.

Over time there may be a pattern that can be developed and be considered to be reflective of the typical Lake behaviour but as the Lake has been dry now for some time there may just be difficulties in attaining these patterns. It is clearly understood that there will be insufficient data to build a detailed water quality profile by the time

of the next management plan but it would be hoped that this will be a considerably more detailed section in that next plan. However in the interim the following actions are recommended:

- Work with the other Lake Managers and develop a set of guidelines as to how to best build up this events based data bank. Review that testing program currently adopted by Council and amended to accommodate this process. Once agreed with the other Lake Mangers have the testing regime formalised by Council.

- Obtain boating access to the Lake for Council officers either through the purchase of such equipment or the leasing of such equipment.

- Prepare a very detailed monitoring section of this management plan for the second management plan for the Lake.

9.0 RECREATION

Lake Albert is well used by the community for both active and passive recreation. When the Lake water levels are higher the water body is used for many aquatic activities including water-skiing, sailing, kayaking, fishing and general recreational boating. There are several local aquatic user clubs and groups that regularly use the Lake including the Wagga Wagga Boat Club, Wagga Aquatic User Group, Scouting Association and Dragons Abreast Club. Annual events such as the Barry Carne water skiing event and triathlon events are also held when there are sufficient water levels.

Equally the Lake foreshores are enjoying significantly increased usage since the completion of the Lake Albert Walkway for passive recreation activities including walking, cycling, jogging, picnicking and dog exercise.

Two concept landscape master plans for Lake Albert foreshores have been prepared in the last five years with the first plans prepared by a consultant landscape architect in 2005. Further more detailed concept designs were prepared in 2008 by Council's landscape designer and these updated the original plans. Both plans suggest future fishing platforms (for when there are higher Lake water levels), picnic nodes at various key locations around the foreshores, irrigated areas and shade tree plantings. These plans are attached as an appendix to this Management Plan.

The final section of the Lake Albert Walkway adjacent to the Wagga Wagga Country Club was completed in July 2007 and is now a full circuit of 5.5km of paved pathway right around the shores of the Lake and is well used on a daily basis. It is also promoted as a health and wellbeing precinct for people with medical conditions with the level gradient of the walkway being ideal for this purpose. The walkway also has distance markers right around the circuit so people can opt to use all or some of the distance.

More recently eight items of gym exercise equipment have been installed on the eastern shore of the Lake near Apex Park as part of a City Partnership project with the Wagga Wagga Business Chamber. This equipment is already proving popular with the community for physical aerobic activity.

Apex Park on the eastern shore is receiving new picnic facilities with three new picnic shelters complete with electric barbecues and picnic tables. A further six new picnic tables have been constructed along the shoreline at this location. These facilities are being installed by the South Wagga Apex Club in partnership with Council. The Club also extended the boat ramp at this location in early 2009 with grant funds from Maritime NSW.

An additional two picnic shelters are also being constructed on the western shores of the Lake at Ray Beddoe Park and Bosley Memorial Park adjacent to the Wagga Wagga Boat Club. These shelters will add to the picnicking opportunities on this side of the Lake. All these new facilities will enhance the popularity of the Lake and its foreshores for recreation opportunities for families and aquatic activities alike.

In spring 2008 Wagga Wagga City Council coordinated the planting of 350 indigenous Eucalypt trees right around the Lake Albert walkway to provide future shade and habitat value. These trees were planted by students from four local schools. Native grasses were also planted along parts of the shoreline over two

community planting days. These trees will provide much welcomed shade in the coming years. These works were funded by a Federal Enviro Trust grant.

The Lake Albert community survey was compiled by Wagga Wagga City Council and put out for community participation during July 2009 and 1,395 people responded to the survey over a four week period. The results of this survey confirmed the high value that Lake Albert is seen by the Wagga Wagga community, and in particular its ongoing recreation value for both active and passive pursuits for both the water body and the foreshores. This is covered in more detail in section 3.2 of the Management Plan.

Even though the Lake water levels are currently low due to the drought, many respondents still felt that the aesthetics and picturesque quality of the water was still an important feature even though it currently can't be used for motorised sport.

Future works that have been requested by the community include more bubblers for the Walkway, shaded picnic areas, the possibility of a café so people can go for a walk and have a coffee, etc. Further comments from the survey included seeing the Lake as a destination place for foreshore recreation, fishing and leisure and keeping the Lake as natural as possible.

Wagga Wagga City Council will continue to enhance and promote the Lake and its foreshores, recognising that it is a destination place which provides for social gatherings and social and recreation activities thus resulting in social connection, all of which contributes to overall community well-being.

10.0 ENVIRONMENT

Biodiversity

Several major wildlife corridors converge and interconnect at Lake Albert. These are the north-south corridors along Cox's Gully, Crooked and Stringybark and northwards along Marshall's Creek to link with the Murrumbidgee River. The major east-west corridor connects Dukes Road in the east through Rawlings Park, the southern edge of the lake through to the Springvale-Glenoak areas and the Silvalite Reserve.

Habitats surrounding the lake provide essential connectivity in these corridors.

Inland Grey Box and the White Box – Yellow Box – Blakely's Red Gum Woodland are two Endangered Ecological Communities that connect to the lakeside vegetation.

Threatened species that inhabit the native vegetation around the lake include: Squirrel Glider, Superb and Turquoise Parrots, Brown Treecreeper and Painted Snipe. Also, suitable habitats for the Southern Bell Frog and Booroolong Frog are provided by the reed beds in the wetland areas.

The objectives for biodiversity management in and surrounding Lake Albert include provision for these attributes:

- Maintain and enhance wildlife corridors across the urban landscape;
- Maintain and enhance wildlife habitats surrounding the lake for both plants and animals and the natural ecosystems of Lake Albert;
- Maintain and enhance aquatic habitats for native fish and freshwater invertebrates; and
- Provide protection for Threatened species and Endangered Ecological Communities that occur in the vicinity of Lake Albert.

Lake Albert Wetland Zone

The lake suffers from low water levels, high nutrient loads and lacks habitat for fish and aquatic life. The aquatic plants of an ephemeral wetland at the northern end of the lake could be significantly linked to the main water body and could help to take up nutrients that have accumulated within the silt and sediment of the lake floor. Natural uptake of these nutrients by plants is one of the few ways that toxic algae causing nutrients such as phosphorus and nitrogen can be removed from the water without dredging of the nutrient rich sediments. There are a number of stormwater drains that discharge into the lake via the proposed area. A wetland will serve to improve the quality of the water reaching the wider lake water body. While this wetland area would provide a natural filter for the water it will also importantly provide a breeding ground for aquatic organisms that feed the fish of the lake. In combination with native fish restocking, carp removal and a fish zone within the lake native fish
should breed and the wetland will serve as a nursery area with abundant food and protection for the small fish before they move into the wider expanse of the lake.

The wetland area, while serving as an important biodiversity area will also provide a passive recreation area for the public to enjoy and will also be suitable for education

purposes that will likely be used by the many close schools as well as others within the wagga area. There is the opportunity for boardwalks throughout the wetland area. The area could become a popular location for passive recreation activities such as bird-watching and photography and provide an alternate route through the wetland for residents that currently walk around the lake for pleasure and for exercise. There are recent records of significant migratory bird species and a wetland would further enhance this habitat. In the proposed location it will further strengthen wildlife linkages down Marshall's creek past the possible wetlands of the Kooringal Treatment works and along to the Murrumbidgee River.

The proposed area of the wetland would cover 12-16ha at the northern end of the lake with a southern boundary in line between Lansdowne Avenue on the western side and Talbingo Crescent on the eastern side. It encompasses an area that isn't used for boating activities due to its shallow nature, even when the lake is full.

Lake Albert Fish Zone

Fishing is a popular activity at Lake Albert, whether from the shoreline or from boats. A purpose designed, built and managed fish area adjacent to and connected to the wetland area would facilitate better management and protection of fish stocks.
This area would be designed in conjunction with experts in the field of fish ecology such as scientists from the Department of Primary Industries (NSW Fisheries). It would likely include deep areas that provide a suitable area for large fish to take refuge away from high speed watercraft. It would be an area that contains large snags for fish to hide in and feed, and would provide breeding locations for adult fish. With connections, the juvenile fish could then move into the wetland area to grow.

Snags in the fish area would not be a safety issue for boating activities as it would be designated as being an area outside of the ski area and speed restrictions would apply and hence be no different to boating in a river environment that is inherent with snags and other boating obstacles. Having such an area would attract more fishing vessels to that area and reduce traffic in a designated ski area and help to increase boating safety.

If the Fish Zone was to extend 200m south from the boundary of the Wetland Zone and the full width of the lake it would encompass approximately 10ha. This would provide a significant area for fish and aquatic invertebrates to inhabit.

The southern boundary of the Fish Zone is still more than 1km from the closest point on the southern shoreline of the lake and leaves approximately 85ha of lake not included within the Wetland or Fish Zones.

Environmental Recommendations

The following actions are recommended to further enhance the environmental aspects of the Lake Albert area:

- Future planting of vegetation around the Lake should be restricted to local indigenous species only

- Over time non-native vegetation should be removed, with initial focus on the remaining willows located at the southern end of the lake
- Small areas of woodlands that replicate local Endangered Ecological Communities should be established adjacent to the lake. Two locations proposed include to the north in the vicinity of Fred White Reserve and to the South in the vicinity of Crooked creek.

- Native grassland areas should be established along strategic sections of the lake to enhance natural ecosystems

- Establish a wetlands area covering 12-16ha at the northern end of the lake with a southern boundary in line between Lansdowne Avenue on the western side and Talbingo Crescent on the eastern side.

- Establish a “Fish Zone” to extend 200m south from the boundary of the Wetland Zone and the full width of the lake, encompassing approximately 10ha.

- Work with Department of Primary Industries (NSW Fisheries) to enhance the fish habitat of the lake, including snagging within the non boating areas and fish restocking programs

- Further investigate programs to manage European Carp within the Lake

References

- NSW Soil Conservation Service (1985), Land Resources Study of the Lake Albert catchment

- Cary Reynolds (2006), Draft Lake Albert Management Plan

- Bureau of Meteorology historical rainfall data

- Wagga Wagga City Council (2009) Lake Albert Community Survey

- Lake Albert Community Committee

ATTACHMENT NO 1

Review of Rainfall Records 1942 to 2009

Set out in this attachment is a review of the rainfall for the Wagga region based on figures provide by the Bureau of Meteorology for this period. The lake has been significantly modified since 1980 and to some extent there is limited value in pursuing details before that period but the table have been set out for this period to provide some historical content.

The enclosed tables provide the following basic observations:

- The period 2000 -2009 has the longest sustained period of rainfall that is below average rainfall with 8 straight years and with two of these years in the six driest years on record and there is likely to be a third dry year based on the first six months of 2009 which has the potential to be the driest year on record. The only other historical period that approximates this is the 1940's with four years of sustained sub average rainfall also including two of the six driest events on record.
- Table A1 demonstrates that the average to the end of 2008 was only 82% (78% to June 2009) of average rainfall slightly less than that of the 1940"s with 85%.
- The decades between these two notable droughts have seen average or above average rainfall as seen in table A1.
- The lake was know to be down in level in the 1940"s and again in 1982 and this is again easily seen in table A2
- The driest year on these records is 1967
- The lake does not require that average annual rainfall be achieved for it to fill rather that there be 4 consecutive months of well above average rainfall. This happened in 2005

Decade	Average Rainfall (mm)	Percentage Average Rainfall	Cumulative Average Rainfall (mm)	Cumulative Percentage Average
1942 – 1949	480	85	480	85
1950 – 1959	632	112	556	98
1960 – 1969	562	99	558	99
1970 – 1979	625	110	575	102
1980 – 1989	570	101	574	102
1990 – 1999	620	110	582	103
2000 – 2008	465	82	564	100

Table A1

Rainfall Trends by the Decade (1942 -2008)

Year	Rainfall (mm)	Percentage Average	Year	Rainfall (mm)	Percentage Average
1940	-	-	80	488.4	86
1941	-	-	81	528.2	93
1942	620.3	110	82	297.8	53
1943	520.8	92	83	771.2	136
1944	251.2	44	84	619.6	109
1945	449.0	79	85	587.2	104
1946	384.1	68	86	586.6	104
1947	566.0	100	87	445.4	79
1948	481.4	85	88	668.8	118
1949	566.2	100	89	704.6	124
1950	819.5	145	90	599.8	106
1951	489.5	86	91	432.4	76
1952	707.7	125	92	923.2	163
1953	575.8	102	93	718.1	127
1954	554.1	98	94	468.6	83
1955	694.3	123	95	714.4	126
1956	989.4	175	96	680.8	120
1957	451.5	80	97	407.8	72
1958	575.2	102	98	561.0	99
1959	462.5	82	99	693.4	123
1960	638.1	113	00	653.4	115
1961	535.4	95	01	488.2	86
1962	531.6	94	02	376.8	66
1963	627.3	111	03	450.2	80
1964	640.5	113	04	494.4	87
1965	417.7	74	05	513.0	91
1966	644.4	114	06	267.2	47
1967	245.2	43	07	466.4	82
1968	583.5	103	08	477.4	84
1969	756.2	134	09		
1970	729.3	129			
1971	692.6	122			
1972	417.0	74			
1973	692.9	122			
1974	926.8	164			
1975	684.8	121			
1976	486.2	86			
1977	425.2	75			
1978	780.6	138			
1979	418.0	74			

Table A2

Annual Rainfall Records 1942 -2008

Notes

1 *The blue shaded area represent more than one consecutive year of less than average rainfall.*

2 *The red shaded area represent the six driest years in the history of Wagga Wagga (1941 to 2008).*

3 *2009 has recorded only 129.6 mm of rainfall to the end of June hence this year is on course for another of the driest years in the history of Wagga Wagga. For this reason it is shown as a red line.*

4 *The table assumes an average annual rainfall of 566mm*

Month	**Average Rainfall (mm)**	**2009 Rainfall (mm)**	**Percent Average**	**Month**	**Average Rainfall (mm)**	**2009 Rainfall (mm)**	**Percent Average**
January	40.6	28.8	71	July	55.3		
February	39.0	8.6	22	August	50.8		
March	41.1	14.8	36	Septembe r	49.9		
April	41.4	31.8	77	October	58.2		
May	50.9	8.2	16	November	44.0		
June	49.7	47.4	95	December	44.4		
Sub Total	**262.7**	**129.6**	**49**		**302.6**		
Total					**565.3**		

Table A3

2009 Rainfall Statistics

Notes:

1 It can be expected that 2009 will lead to significant reductions in the lake levels

2 Some deepening of the northern end of the lake was also carried out.

Further observations in relation to the Lake record the following:

- The Lake has filled even when there has not been an average rainfall year as occurred in 2005
- The catchment needs significant pre-wetting before it will produce flows through the two main water sources (Crooked and Stringybark Creeks)
- Table A4 shows where there are at least three consecutive months of above average rainfall (approx 45 mm per month) in the period 2000 - 2008
- In 2000 there were 486 mm over 7 months (particularly based around the cooler months) and the Lake overflowed.
- In 2003 there was 197 mm over three months (again over winter) and there is some feedback of some water flowing into the Lake but nothing can be confirmed for this period without effective record keeping.
- In 2005 there was 353mm of rain and the Lake was observed to commence flowing after around 120 mm of rainfall and was overflowing in October of the year. This was again during the cooler months when pre - wetting the catchment was likely to require less water.
- In 2007 -2008 there was 287.2 mm but Council observations of this period failed to record any significant inflows into the Lake. Unlike the previous period this occurred in the warmest months and pre-wetting requirements would have been maximised.

Month	**Rainfall per Month (mm)**									
	00	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**Ave**
Jan	62.8	22.8	3.6	7.0	22.8	13.2	69.4	40.2	75.2	**35.2**
Feb	26.6	86.4	139.8	58.6	9.4	46.8	1.8	54.6	64.4	**54.3**
Mar	26.0	56.6	24.0	1.6	0	6.6	10.6	23.8	23.4	**19.1**
Apr	61.6	31.2	25.0	9.2	15.4	14.6	17.4	46.0	29.8	**27.8**
May	71.8	8.0	30.2	28.4	40.8	4.6	4.6	52.4	14.8	**28.4**
Jun	55.0	62.8	50.8	69.4	73.4	69.0	39.4	19.4	39.6	**53.2**
Jul	56.4	31.6	14.4	60.2	38.0	65.0	49.2	38.2	58.4	**45.7**
Aug	92.4	47.6	32.4	67.2	66.8	56.4	7.6	22.2	24.8	**46.4**
Sep	46.8	39.2	36.0	26.0	53.6	85.0	20.0	7.4	26.6	**37.8**
Oct	102.0	86.8	0.6	55.4	26.0	77.6	3.8	14.6	17.4	**42.7**
Nov	32.4	12.0	12.2	28.0	87.6	44.8	34.0	73.0	54.6	**42.1**
Dec	19.6	3.2	7.8	39.2	60.6	29.4	9.4	74.6	48.4	**32.5**
Total	**653.**	**488.**	**376.**	**450.2**	**494.4**	**513.0**	**267.2**	**466.4**	**477.4**	**465.2**

s	**4**	**2**	**8**							

Table A4

2000 – 2008 Monthly Rainfall

Whilst the simple answers to the failure to generate runoff in the 2007-2008 period was that this occurred in the hot months and clearly it will depend on the exact nature of the rainfall, there is still some basis for residents to have had some expectations of some runoff to have been generated in period. As such there is a strong need to have a greater understanding of exactly what is occurring in the catchment.

Table A5 details the performance of the Lake in this dry period of 2001 – 2008 against the longer term performance of the Lake. In general this period has been around 18% drier than normal to the end of 2008, but if the period is extended to June 2009 this becomes 22% drier.

February has been the only month to exceed the longer term averages and June, July August and November have proven to be closer to average rainfall levels with the remainder of the months falling well below the average rainfall levels. Hence the cooler months have proven more reliable.

Month	**Long Term (mm)**	**2001 - 2008 (mm)**	**Gap (mm)**	**Month**	**Long Term (mm)**	**2001 - 2008 (mm)**	**Gap (mm)**
January	40.6	35.2	-5.4	July	55.3	45.7	- 9.6
February	39.0	54.3	+15.3	August	50.8	46.4	- 4.4
March	41.1	19.1	-22.0	Septembe r	49.9	37.8	-12.1
April	41.4	27.8	-13.6	October	58.2	42.7	-15.5
May	50.9	28.4	-22.5	November	44.0	42.1	-1.9
June	49.7	53.2	+3.5	December	44.4	32.5	-11.9
Sub Total	**262.7**	**218.0**	**44.7**		**302.6**	**247.2**	**55.4**
Total					**565.3**	**465.2**	**100.1**

Table A5

Comparing 2001 to 2008 with the Long Term Rainfall Averages

Table A6 better records what is enfolding in 2009

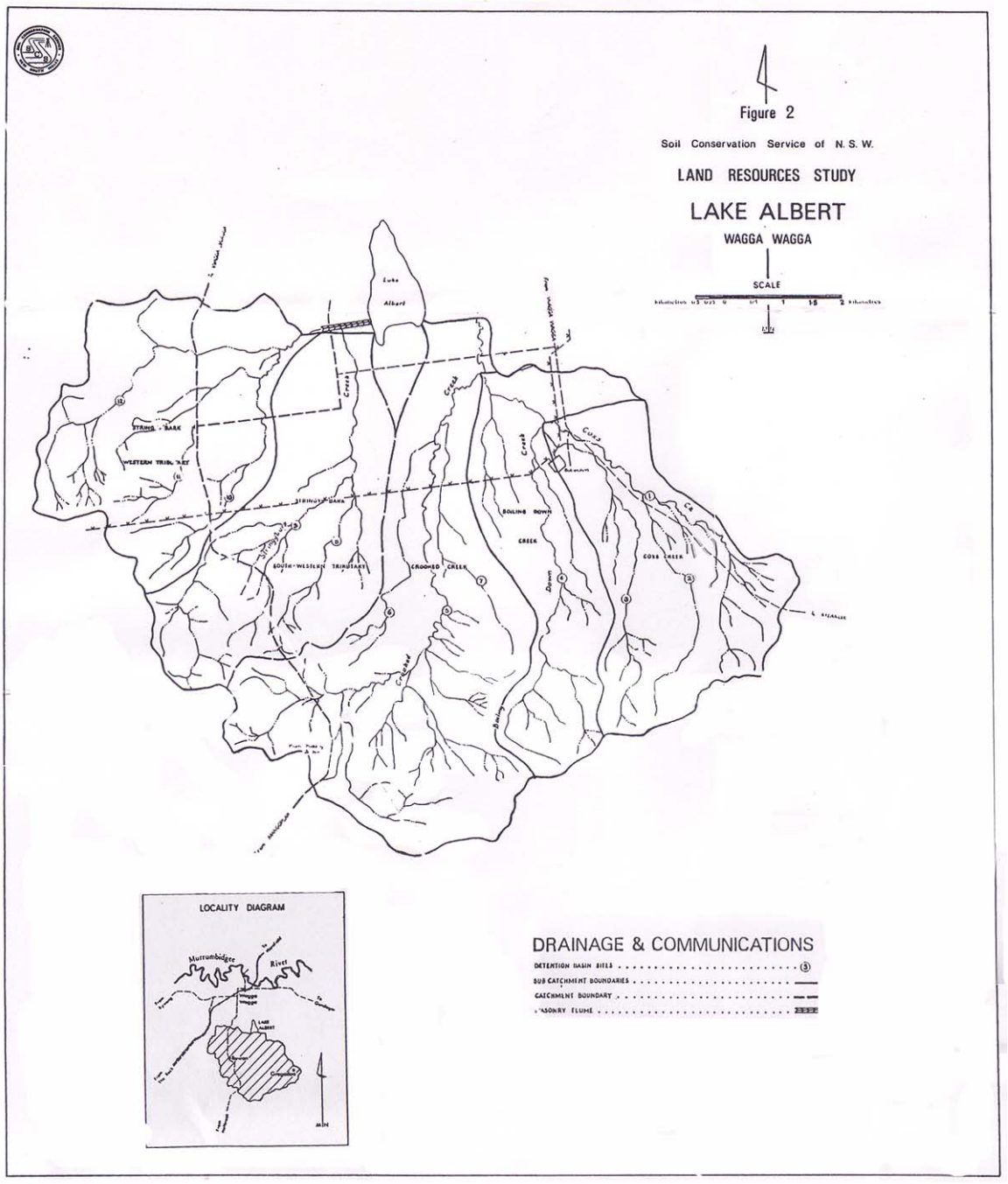
Month	Long Term Ave (mm)	2001 - 2008 (mm)	1967 (mm)	2009 (mm)	2009 Performance		
					Gap to Long Term Ave (mm_	Gap to 2001 - 2008 (mm)	Gap to 1967 (mm)
January	40.6	35.2	57.7	28.8	-11.8	-6.4	-28.9
February	39.0	54.3	1.0	8.6	-30.4	-45.7	+7.6
March	41.1	19.1	11.8	4.8	-36.3	-14.3	-7.0
April	41.4	27.8	0.5	31.8	-9.6	+4.0	+31.3
May	50.9	28.4	25.5	8.2	-42.7	-20.2	-17.3
June	49.7	53.2	29.8	47.4	-2.3	-5.8	+17.6
Sub Total	**262.7**	**218.0**	**126.3**	**129.6**	**-133.1**	**-87.2**	**+3.3**
July	55.3	45.7	9.0				
August	50.8	46.4	42.0				
Sept	49.9	37.8	24.9				
Oct	58.2	42.7	29.8				
Nov	44.0	42.1	12.7				
Dec	44.4	32.5	0.4				
Sub Total	**303.3**	**247.2**	**118.8**				
Total	**566.0**	**465.2**	**245.2**				

Table A6

2009 Performance in Greater Detail

ATTACHMENT NO 2

LAKE ALBERT CATCHMENT PLAN



Lake Albert Catchment
(From a Soil Conservation 1985 Report)

ATTACHMENT NO 3

FURTHER COMMUNITY FEEDBACK

In addition to the community feedback on Lake Albert, included as part of Section 3.0 of this Management Plan, the following feedback is also recorded. However in so doing, it is also highlighted that this 2009 market research was a voluntary study, wherein the responsibility to respond fell to the community, and hence those with some interest in the Lake can be expected to form the bulk of respondents. This is therefore not necessarily representative of the wider Wagga Wagga community and a new balanced survey would be required before these figures could be used as a mandate for anything.

	Aspects	**Respondents**	**Percentage of Respondents**
1	Aesthetics /Picturesque	958	69
2	Water Sports	945	68
3	Boating	891	64
4	Bird Life	746	54
5	Fishing	701	50
6	Other	155	11
7	Nothing	33	2

Table A3.1

Responses to the Question "What aspects of the Lake do you like?"

Note:

Other was defined as sailing, triathlon, tranquillity, canoeing etc)

The total number of respondents to the question was 1392. Confusing aspects in the interpretation of these results are:

- There does not appear to be a definition of what water sports is and hence some of the other aspects may have become lost in this.
- Total answers were 4429 (or 3.2/respondent) but how well were these averaged across the respondent range.

It would appear that of the respondents there was considerable support for the Lake.

	Uses	Respondents	Percentage of Respondents
1	Water Sports	767	
2	Boating	669	
3	Fishing	499	
4	Other	312	
5	Nothing	206	

Table A3.2

Responses to the Question "What do you use the Lake for"

Notes:

1 Other was defined as swimming, triathlon, kayaking, general socialising etc)

2 Water sports would be a large percentage water skiing

	Aspects	Like	Use
1	Walking	1236	1180
2	BBQ/Picnics	847	874
3	Cycling	834	675
4	Jogging	733	573
5	Facilities	642	559
6	Other	134	166
7	Nothing	37	38
	Respondents	**1391**	**1384**
	Answers	4463	4065

Table 6.1

Responses to the Questions "What do you like about the foreshore" and "What do you use the foreshore for"

Note:

1 Other was defined for first question as launching area, playgrounds walking paths picnics, etc)

2 Other was defined for second question as boat ramp, dog walking, bird watching fishing, relaxing

ATTACHMENT NO 4

POSSIBLE AGENDA FOR FIRST MEETING OF MANAGEMENT COMMITTEE

It has been recommended that a formal meeting be held with all of the Government Departments with responsibility for the Lake at least once each year. The following could represent a suggested agenda for that meeting.

Agenda

1 Committee Arrangements

2 Catchment Study

3 Draft Management Plan

4 Soil Conservation Report on Catchment

5 De-Proclaiming Marshall Creek

6 Stormwater Harvesting Study

7 Sediment Removal

8 Potential for Fish Habitats

9 Golf Course

10 Flood Mitigation Plans for Lake Albert

11 General Business

Attachment 5

Works Program for Proposed Actions

To ensure the appropriate allocation of limited resources to Lake Albert requires some prioritisation of the suggested primary actions arising from this management plan. However it is considered that a simple priority listing will prove insufficient as many of the actions would share similar priorities but some would require prerequisite tasks are carried out first, before the suggested action can realistically proceed. Hence the suggested work program as set out in the table below has been created to act as a guide as to when and in what sequence the suggested actions should be undertaken.

It has also been proposed that there will be a formal accountability to the community for progress against this Management Plan thus the table provides the basis on which to review this progress at the proposed community forums. The table also breaks down each of the proposed actions (recommended in the body of this management plan) into:

- Suggested sub tasks required for the action to be fully carried out.
- Estimated time scale for each of the sub-tasks.
- Estimated costs for the actions.

It is stressed that this management plan is for five years, and as such it needs to be recognised that not all tasks can or indeed should be done at the same time, due to resources constraints and the need to carry out the tasks in a logical order. Accordingly the tasks have been set out in a time scale based on perceived order of priority however this may alter from time to time and in particular should the lake commence to fill.

2014 will appear somewhat light in the table and this is deliberate as it is expected that resulting from some of the initial actions a further list of tasks (or new actions) will be created and many of these will need to see some periodic readjustment of the works program. Actions such as the following are expected to spurn a number of further tasks to fully deliver the Management Plan:

- The Catchment Study
- The Stormwater harvesting Project

The works program is a guide only and should not be taken as an absolute, as clearly some projects will slip whilst others will accelerate. None of the projects has been scoped in any detail and as such some revision may be required. Similarly any estimates provide are also little more than very preliminary estimates for the same reasons as set out for the works program.

Works Program Lake Albert Management Plan

	Action to be Undertaken	Proposed Time Frame
1	**Carry out a detailed review of the Lake Albert Catchment.**	**Oct 2009 – Feb 2011**
1.1	– Write to the NSW government seeking that they join Council in a joint study of the catchment	Letter already sent – response awaited Nov 2009
1.2	– Review Soil Conservation report on Stringybark Creek	Oct – Nov 2009
1.3	– Scope the study to be carried out	Dec 2009 – Feb 2010
1.4	– Fly the catchment	March 2010
1.5	– Finalise project team	April 2010
1.6	– Carry out investigation of the catchment	April – June 2010
1.7	– Draft report	July – Aug 2010
1.8	– Peer review	Sept – Oct 2010
1.9	– Finalise report	Nov 2010 – Feb 2011
	Estimated Costs to Council this Action Consultant Fees Aerial Survey Staff Hours	 **$35,000** **$10,000** **50 hours($6000)**
2	**Have Marshall's Creek de-proclaimed**	**Dec 2009 -2010**
2.1	– Write to NSW Government	Dec 2009
2.2	– Response from government	Feb 2010
2.3	– Actions as may be required in government response	As required
	Estimated Costs to Council of this Action Staff Hours Miscellaneous	 20 hours ($2500) Unknown

	Action to be Undertaken	Proposed Time Frame
3	**Engineering Review of Potential Stormwater Harvesting options to fill the Lake**	
	Pre-Requisite Activity: *De-proclamation of Marshall's Creek to allow for its usage in expanded stormwater role.*	
3.1	– Preliminary investigation of major stormwater mains in close proximity to Lake Albert	Feb 2010 – March 2010
3.2	– Scope the proposed investigation	April 2010
3.3	– Carry out option investigation	May 2010 – Sept 2010
3.4	– Preliminary report	Nov 2010
3.5	– Refer to all internal and external agencies for peer review	Dec 2010 – Feb 2011
3.6	– Community consultation	March 2011
3.7	– Finalise Cost Estimates	April 2011
3.8	– Finalise Report	April 2011 – May 2011
3.9	– Submit to Council	May Council Meeting
	Estimated Costs to Council of this Action Consultant Fees Drafting Council Review	$35,000 30hours ($4,000) 25 hours ($3,000)
	Note: *Other projects may arise as a result of this action and it is expected that the program will increase considerably as a result of this investigation.*	
	There may be further delays here if a Review of Environmental Factors or EIS are required before anything can proceed.	

	Action to be Undertaken	Proposed Time Frame
4	**Contact Federal and State Government Departments in relation to removal of sediment from Lake Albert**.	
4.1	– Draft letter seeking potential funding for projects	Nov 2009 – Dec 2009
4.2	– Meet with State and Federal members to identify potential agencies and seek support, including input into letter	Feb 2010 – March 2010
4.3	– Write to agencies seeking funds	March 2010
	Note *Other actions may arise depending upon the response received. Actual further works will depend upon lake levels at the time, availability of plant and machines, when funding available (if available)*	*Opportunity based*
	Estimated Costs to Council of this Action Staff Hours	15hours ($2,000)
5	Constitute and establish a joint or Interdepartmental Management Committee for Lake Albert.	
5.1	– Council to write to relevant NSW agencies seeking interest in participation in committee	Nov 2009 – Feb 2010
5.2	– Act on comments received and identify members of Committee	Feb 2010 – March 2010
5.3	– Finalise agenda first meeting/ prepare items for discussion.	April – May 2010
5.4	– Hold first meeting	May – June 2010
	Estimated Costs to Council of this Action Staff Hours	65 hours/annum ($8,000)/annum
	Note: *Other activities to follow from first meeting including time scale for future meetings*	

	Action to be Undertaken	Proposed Time Frame
6	**Call for expressions of interest for fill from Lake Albert**	
6.1	- Confirm with all other relevant agencies details of purpose	Dec 2009
6.2	- Work out details	Jan 2010
6.3	- EOI open	All Feb 2010
6.4	- Collection period	March 2010 (2 weeks)
	-	
	Estimated Costs to Council of this Action	$25,000 / application
	Note *Other applications will depend upon:* - *Results of initial EOI.* - *Levels of the Lake* - *Weather at h e Time.*	*Repeats Opportunity Based*
7	**Establish an automated device for monitoring of levels in the lake**	
7.1	- Investigate nature of technology to be installed	March – May 2010
7.2	- Determine location	May 2010
7.3	- Detailed design of system	June – July 2010
7.4	- Install unit	Aug 2010
7.5	- Test and commission monitoring device	Sept 2010
	Estimated Costs to Council of this Action Supply and Install the Monitoring Device Staff Hours	$40,000 80 hours ($10,000)
	Note: *This device may be installed in part if lake levels rise as it will be too difficult/ costly to lay horizontal pipeline when the lake is higher.*	

	Action to be Undertaken	Proposed Time Frame
8	**Review of Basix Requirements**	
8.1	Investigate and prepare discussion papers for internal circulation	March – May 2010
8.2	Comments back	May – June 2010
8.3	Final paper to Council	September 2010 council meeting
8.4	Further actions as required	As required
	Estimated Costs to Council of this Action	As Required
9.0	**Review Wetlands Requirements in Lake Albert Subdivision Proposals**	
	Pre-Requisite Activity *Soil Conservation Report on Stringybark Creek Sediment needs to be finalised*	
9.1	- Review soil conservation report.	Oct 2009 – Feb 2010.
9.2	- Review and prepare paper for internal circulation.	April 2010 – Sept 2010
9.3	- Comments back.	Nov 2010 – Feb 2011
9.4	- Final paper to Council	March 2012
	Estimated Costs to Council of this Action	As Required

	Action to be Undertaken	Proposed Time Frame
10.0	**Determine the Revenue Raise by the Existence of Lake Albert as well as other triple bottom line benefits**	
10.1	Develop a consultancy brief and workshop that brief with the community and management committee.	By April 2010
10.2	Call for expressions of interest to carry out the study and select a preferred tenderer based on their methodology and general likely credibility of their results	By June 2010 with recommendation to June Council meeting
10.3	Carry out the study	July to October 2010
10.4	Workshop study results until agreement reached by all parties if possible	November 2010 – February 2011
10.5	Formally adopt these figures for use in all decision making	April Council Meeting 2011
	Action to be Undertaken	**Proposed Time Frame**
	Estimated Costs to Council of this Action	Consultancy Fees $50,000 Council Officer Input 160 Hours ($20,000)
11	**Create an Issues Register for the Lake**	**Jan 2010 - 2014**
11.1	– Prepare document including formalising the procedures for entering issues n the register	Jan – June 2010
11.2	– Advise community groups of the existence of the register and seek their input into its format, mechanisms for access and the issues of concern to them	July – Oct 2010
11.3	– Review mechanisms for raising appropriate issues from the register into the Management Plan	Sept – Nov 2010
11.4	– Review the effectiveness of the Register	At all open and formal reviews of progress against the Management Plan
	Estimated Costs to Council of this Action – Capital Investment – Staff Time	Nil 50 hours per annum($5,000)

	Action to be Undertaken	Proposed Time Frame
12.0	**Construct sediment capture mechanisms on Crooked Creek to reduce volumes of sediment entering the Lake**	**Jan 2011 – 2014**
12.1	– Investigation of potential measures that can be installed, based on catchment study which should be carried out first	Jan – Feb 2011
12.2	– Pursue proposed control mechanisms with other government agencies through the management committee	March – May 2011
12.3	– Preliminary Design of the Control Measures	June – July 2011
12.4	– Formalise any "Approvals" required	Aug – Sept 2011
12.5	– Modify and finalise any design requirements arising from the formalisation process	October 2011- Jan 2012
12.6	– Ongoing construction of structures	2012 – 2014
12.7	– Review effectiveness of the Structures	2012 – 2014
12.8	Modify structures as required.	2012 – 2014
	There may be further delays here if a Review of Environmental Factors or EIS are required before anything can proceed.	
	Estimated Costs to Council of this Action – Capital Investment (small scale structures) – Full pollution control rack – Operational Costs /annum to clean out structures	 $150,000 $800,000 $20,000

	Action to be Undertaken	Proposed Time Frame
13.0	**Prepare a formal Flood Management Plan in relation to Lake Albert and surrounding areas including downstream to the Murrumbidgee River**	
	Pre-Requisite Activity: *The storm water harvest proposal should be known first before proceeding with this action.*	
13.1	– Investigate and scope the nature of the proposed Plan	April 2012 to June 202
13.2	– Develop draft plan	July – Oct 20102
13.3	– Workshop Plan with proposed joint management committee	Nov 2012 – Jan 2013
13.4	– Workshop Plan with SES	Nov – December 2012
13.5	– Review Plan based on feedback and modify as required	Feb 2013
13.6	– Public Display and feedback on Plan	March to April 2013
13.7	– Finalise Plan	April –June 2013
13.8	– Adopt Plan	June 2013 Council Meeting
	Estimated Costs to Council of this Action Consultants Staff Input Miscellaneous	 $25,000 150 hours ($15,000) $5,000

	Action to be Undertaken	Proposed Time Frame
14.0	**Explore the potential to irrigate the golf course with effluent from the augmented treatment plants.**	**Nov 2009 -2014**
	Pre-Requisite Activity: *The new treatment plants will need to be fully commissioned with all performance testing completed before supplying an additional reuse customer can be contemplated*	
14.1	– Develop proposal and costs involved	Nov 2009 –February 2010
14.2	– Review proposal and costs with Golf Club Management	March 2010
14.3	– Assuming costs acceptable to Golf Club review the proposal with DECCW	April 2010
14.4	– Gain Section 180 approval to const	April 2010 - ????
14.5	– Construct	After 180 approval given
14.6	– Monitor	Ongoing to 2014
	Estimated Costs to Council of this Action – Capital – Staff Input – Monitoring	 $240,000 180 hours ($20,000) 65 hours /annum ($8,000)
15.0	**Seek to have a Peak Community Forum created to represent the users of the Lake**	
15.1	– On release of the draft management plan seek expressions of interest from the community on how best this maybe achieved.	December 2009 –April 2010
15.2	– Work through the issues and proposals with additional work likely to be required to clarify matters	Feb 2010 – September 2010

	Action to be Undertaken	Proposed Time Frame
15.3	– Seek to streamline proposals and move towards a resolution at the first community forum to review progress against the management plan and in particular this works program.	October 2010
15.4	– Seek to have the final solution finalised and submitted back to Council and the proposed management committee	When submitted
15.5	– Implement Body and communication arrangements	2010
15.6	– Review success of the arrangements	Ongoing at each of the public forums to review the Plan or in response to a specific need.
	Estimated Costs to Council of this Action Staff Input	75 hours($8,000)
16.0	**Review the Ongoing Monitoring of Lake Albert**	
	Pre-Requisite Activity: *The establishment of the new joint management committee will greatly assist this action as there needs to be some consensus and sharing of information through all of these bodies*	
16.1	– Discussion paper to be drafted and circulated to management committee on how to best monitor the lake collectively into the future.	For second meeting of the Management Committee
16.2	– Finalise proposed monitoring arrangements and submit to committee members out of session	2011
16.3	– Adopt new program if required	1/1/12

	Action to be Undertaken	Proposed Time Frame
16.4	– Review program and modify for next year	1/1/13
16.5	– Secure boat access for Council officer to sample water quality in the middle of the Lake	As soon as can be practically achieved . Potentially have thee costs included in 2009/2010 budget.
16.5	– Ongoing monitoring of the Lake and the discernment of trends	
	Estimated Costs to Council of this Action Staff Hours	Unknown at this time
17.0	**Inclusions of the Fish Habitats in the Lake**	
17.1	Initial discussions with NSW Fisheries.	Jan – Feb – 2011
17.2	Investigations as appropriate.	(after other investigations are carried out)
17.3	Discussions with Lake Albert Management Committee Members.	March 2011 - June 2011
17.4	Develop detailed proposals as comment discussion paper.	July – Sept 2011
17.5	Consultation with lake users and community.	Sept – Oct 2011
17.6	Finalise proposals.	Nov 2011 – Jan 2012
17.7	Construct	Feb – May 2012
17.8	Monitor	2012 -2014
	Estimated Costs to Council of this Action Capital Costs Staff ours	$25,000 45 hours ($6,000)

	Action to be Undertaken	Proposed Time Frame
18.0	**Detailed Survey Around Lake**	**March 2010 – Oct 2012**
18.1	- Determine where survey work required.	March 2012 – April 2012
18.2	- Carry out detailed survey.	May – July 2012
18.3	- Produce report on potential to raise Lake.	Aug – Oct 2012
18.4	- Report to community forums	Oct 2012
	Estimated Costs to Council of this Action Survey Staff Hours	 $15,000 40 hours ($5,000)
19.0	**Clean up the Lake Community Initiatives**	
19.1	- Discuss what needs to be done each year to at community forums, reporting progress.	Sept– Oct each year.
19.2	- Instigate actions as appropriate	As required.
	Estimated Costs to Council of this Action	**Unknown mainly time in lieu**