NSWIC
NEW SOUTH WALES IRRIGATORS' COUNCIL

PO Box RI437
Royal Exchange NSW I225
Tel: 02 9251 8466
Fax: 02 9251 8477
info@nswic.org.au
www.nswic.org.au
ABN: 49 087 281 746

Standing Committee on State Development

Adequacy of Water Storages in NSW

Questions Taken on Notice

121212

NSW Irrigators' Council appreciated the opportunity to appear before the Standing Committee on State Development[1] in Sydney on Friday 16 November 2012.

During our session, several questions were taken on notice. These questions and the subsequent answers to these questions are below.

Questions taken on notice:

1. **The Hon. PAUL GREEN:** The thought that I am getting to is what else can be done from the Government's point of view to encourage the farmers to, for instance, move towards bankless channels? I do not know the ratio of the use of energy from a lateral irrigation to a bankless channel. Is there a ratio in terms of energy use? The bankless channels seem to run with gravity-fed water systems as opposed to the lateral irrigation, which needs to be driven by electricity or some other sort of driver for big irrigations. Is there a ratio of energy towards those, like 70 per cent of energy use as opposed to 30 per cent on a bankless channel thing?

2. **The Hon. RICHARD COLLESS:** How was the Keytah trial funded?
   (Group planning a trip to Moree to look at some of the issues, might take time to go have a look at this. Contact details of who to talk to.)

3. **The Hon. PAUL GREEN:** Your submission suggests that consideration should be given to the use of en-route storages where water could be parked if the ordered water is no longer required. What would be the benefits of such an arrangement and where should such en-route storage facilities be located?

4. **The Hon. MICK VEITCH:** If we were to look at some really innovative things that we are not doing in Australia that we could do, can you point us in that direction? Where should we look? For example, we heard about Israel.

   (In other words: Have other countries implemented innovative technologies / management practices / infrastructure that we are currently not using in Australia?)

5. **The Hon. STEVE WHAN:** On a different topic, there have been around the State quite a few different schemes that have funded on-farm savings for irrigators, quite a few different models. In the Northern Rivers there was a federally funded program where the irrigator kept half the savings and half went to the environment.
   There were some done by Waters for Rivers where they did on-farm piping and things like that. I am not asking a question about the technologies that have been used or the methods that have been used. Do you have a view on what sort of model of funding is most effective for on-farm savings? Which model of funding provides the most incentive for it to happen?

[1] Committee website - www.parliament.nsw.gov.au\statedevelopment

6. Your submission indicated that very little information is available from the relevant State department about any predictive modelling utilised to determine future water requirements for agriculture, industry and the environment.
    a. what predictive modelling has been completed that you are aware of in NSW, as well as other Australian jurisdictions?
    b. who conducted the predictive modelling and is it publically available?
    c. In your opinion, what is the world's best practice for completing the predictive modelling you expect as the minimum standard for NSW?

Replies to the questions on notice

1. Efficiency and energy use of irrigation systems - Bankless Channel vs. Lateral

To learn more about the progress being made with Bankless Channel development, a report prepared by the Department of Employment, Economic Development and Innovation (More Profit Per Drop team) entitled "Bankless Channels – Bullamon Plains" is an excellent summary of what the benefits to a bankless channel can be. The team were contracted to deliver the extension component of the Healthy HeadWaters Water Use Efficiency (HHWUE)[2] project.

The report[3] discusses the development changes that evolved with bankless channels on the property, reasoning behind implementing this system as well as information on design, costs and benefits associated with the system. Additional information can be obtained by contacting Lance Pendergast.[4]

A further comparison project that examines the trade-off between energy efficiency and water efficiency is the Keytah project, lead by Gwydir Valley Irrigators Association (GVIA).

This grower led trial was designed to provide accurate comparative information on the water use efficiencies of four relatively common irrigation systems used across Australia and around the world. The information would then help growers make more educated decisions on their irrigation practices in turn maximizing their productivity per megalitre.

The four systems and the size of the trial area were drip irrigation (11.43 hectares), bankless channel (32.53 hectares), furrow irrigation (85.69 hectares) and two lateral moves (122.95 and 122.99 hectares each).

Each system was trialled over two-seasons; 2009-2010 and 2011-2012. Maintaining consistent management of each irrigation system meant plant variety, planting techniques, plant spacing, fertilizer, herbicide and insecticide management were all consistent.

The entire report should be reviewed to fully appreciate all the factors affecting the results, however, for this summary the following two charts will give an indication as to some of the outcomes.

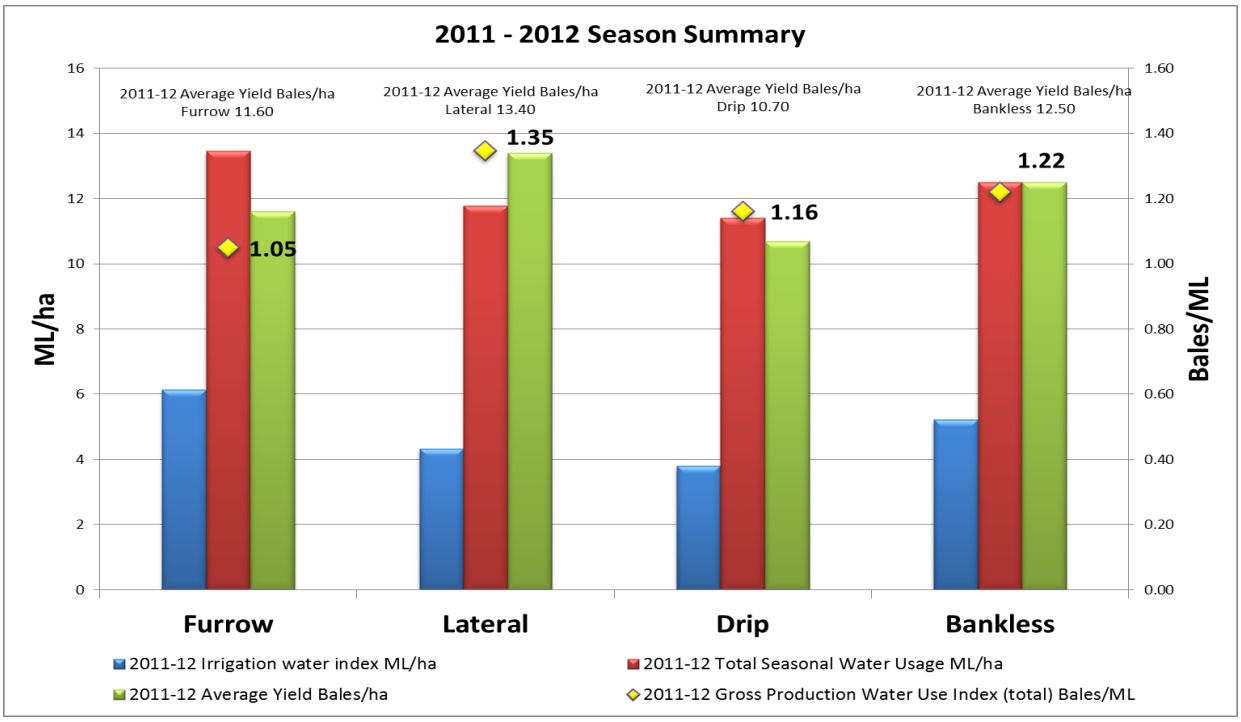
---

[2] HHWUE is managed by DERM and funded by the Australian Government as part of the Sustainable Rural Water Use and Infrastructure Program under the Water for the Future initiative.

[3] More Profit Per Drop – Bankless Channels – Bullamon Plains (http://moreprofitperdrop.files.wordpress.com/2012/01/wueinvhh_bankless-channels-case-study_final-_2_.pdf)

[4] Lance Pendergast - Lance.Pendergast@deedi.qld.gov.au

2011-2012 Season Summary: The water applied and used by the crop for each system is presented with its average production output. Total seasonal water use and production indices are then combined to determine the GPWUI. Variation between the systems is evident and is believed to be linked to the field variation.



Summary of input system costs:

Input	Furrow	Lateral	Drip	Bankless Channel
Capital Setup Costs	• Existing system developed 20 years ago setup cost would not be relevant. • Estimated setup cost today = **$800-$1,200/Ha.**	• Actual costs in 2006 • Machine = $3,200/Ha • Earthworks = $680/Ha • **Total = $3,880/Ha**	• Actual costs 2009Total • **Cost = $8,547/Ha**	• Estimated setup cost today = **$1,000-$1,500/Ha.**
Estimated Ongoing Maintenance Cost per Annum	$61.50 / Ha	$92.00 /Ha	$79.00 / Ha	$32.00 / Ha
Operating Energy Cost (Fuel usage)	1.15 litres per meg per Ha	35.4 litres per meg per Ha	37.5 litres per meg per Ha	0.72 litres per meg per Ha
Estimated Operating Labour Cost (in hours) to irrigate the cotton crop.	0.67 hours per Ha for season	0.30 hours per Ha for season	Actual - 5.24 hours per Ha for season *(NOTE-Very high due to the small scale).* Estimate of an Optimal System (fully automated on 100 ha's +) 0.21 hours per Ha per season	0.58 hours per Ha per season

As this is only one trial and the sample size is quite small, these results are by no means conclusive. This information however is helping to build the profile of each system and with continued support, it will assist farmers to match their soil, land and crops to the system which will produce the best results as efficiently as possible.

We must stress however that there is no one ideal system for all irrigation areas. The trials done in Moree will generate information directly related to their area, but not necessarily to the same degree for other areas. The landfall, soil type, access to water, crops grown and weather all play a part in determining what irrigation methods are the most efficient in different areas.

For a brochures containing final result summaries and discussions go to the GVIA website www.gvia.org.au.

2. Keytah Trials

Please refer above for the details on the trial. GVIA initially put this program together with the assistance of local irrigators. The three year project was approved and funded by the National Water Commission under the Raising National Water Standards Program.

The project, entitled “Improving Irrigation Efficiency” commenced in January 2008. Now no longer funded by The National Water Commission, the program was taken up by The Cotton Research and Development Corporation.

Contact details:
Gwydir Valley Irrigators Association
Zara Lowien - Executive Officer
zara.lowien@gvia.org.au
Ph: 02 67521399
Mob: 0427 521399
Fax: 02 67521499
458 Frome Street
(PO Box 1451)
Moree, NSW, 2400

3. En-route Storages

NSWIC would like to reiterate the importance of evaluating the costs associated with and benefits derived from any new storages that could be viable. New storages (such as a dam) must increase the catchment area or be able to capture large volumes of already regulated water that has been released (dam spill, creating space for flood, etc.).

Merely capturing already regulated water is not increasing the amount of water stored, only holding it in a different geographical location.

If we are looking at the efficient use of water, an option such as en-route storage, which allows water that has already been released to be re-captured so it can still fulfil its productive capacity, is very smart.

Exact locations have not been pinpointed, however Ron Pike has identified a location East of Narrandera, where a natural formation on the river would allow for such a storage. The feasibility of this location along with the costs and benefits associated with the suggestion would need to be evaluated, but the concept we believe is sound.

To add to the references which were submitted regarding new dam sites, we have included some information on Murray Gates, Chowilla Dam and the Lake Mejum proposals.

Murray Gates
A document accompanying this paper (entitled "Murray Gates Proposed Dam") explains in detail the work which was carried out in 1966.[5]

The document goes on to identify a location "The most favourable site on the Murray River for a dam with a large storage capacity located upstream of the junction of the Murray River and the Swampy Plain River is at a site know as Murray Gates"[6]

Having a storage capacity of approximately 444GL, this site could capture and store water which is being released from other storages as well as unregulated water.

Chowilla Dam

This site is unique in that it covers approximately 1,000 square kilometres across three States. The benefits would be shared as there is potential for it to have a capacity of over 5 million megalitres.

Capturing unregulated flows from the Kiewa, Broken, Ovens, Goulbourn, Campaspie, Loddon and Avon rivers which flow into the Murray below Hume, this proposal has the capacity to increase overall storage.

Lake Mejum

A report prepared by the Shires of Balranald, Carrathool, Griffith, Hay, Jerilderie, Leeton, Murrumbidgee, Narrandera and Urana; the Council Councils of Murrumbidgee and Southern Riverina; the Lowbidgee League and the Ricegrower's Association of Australia, is attached to this paper.

[5] Snowy Mountains Hydro-Electric Authority – Proposed Dam at Murray Gates on the Murray River (1966)
[6] Page marked #3 – point 4. Location of Dam Site

This in-depth report covers the history of this site, the benefits which could be derived from it and the costs associated with the plan.

This site differs from others in that there would be piping and pumping requirements to utilise it. With today's high energy costs, the plan would require further work to alleviate the additional costs associated with operating it. Although there are these additional costs, the ability to store up to 450,000 ML would be of great benefit not only in drought years but consistently for the local environment and town use.

4. Innovative technologies / management practices from around the world

Our CEO, Andrew Gregson is currently preparing a report on his recent trip to Israel. This report will contain information on the systems being utilised there and the lessons we can learn from them. This report will be forwarded to the panel upon completion.

Australia has some of the best farmers in the world and their knowledge of irrigation methods and new technologies have meant there is very little being done around the world that has either not been trialled or already implemented here. The challenge is to share these ideas with other farmers around Australia.

A program, like the one run by NSWIC entitled "Sharing the Knowledge", is an example of this. This program was funded on the premise that new innovation in isolation is only partially useful. The sharing of information and knowledge between groups and individuals is what will drive further innovation in the industry.

5. Most effective funding model

Future funding programs need to be proportionate to the risk involved. The greater the risk the greater the uncertainty and hence the smaller the proportion of water that should be given to the Environmental Water Holder in return for infrastructure funding.

With the implementation of on-farm infrastructure irrigators are effectively trading an appreciating asset for a depreciating asset. In other words, the value of the equipment and farm works will decrease over time and incurs rising costs to continue operating (increase in energy prices). A water entitlement on the other hand will most likely increase in value into the future because of greater competing demands for this scarce resource.

Council cannot identify one funding model that is better than all others. Due to the sheer number of variables involved, there is no one model which could be utilised to deliver optimal benefits for the environment, water users or the government. Each project should be evaluated on its own merits, the ratio of funding to water return needs to be based on several factors associated and hence a 'one size fits all model' would be inappropriate.

We therefore recommend that a range of schemes will be necessary to cover the breadth of operations, types of works, types of infrastructure and geographic differentials.

6. Predictive Modelling

We again contacted State Water and the NSW Office of Water to ask about predictive modelling. In both cases the reply was the same, no predictive modelling for consumptive water uses has been undertaken.

The explanation as to why was understandable, but we believe short sighted. The departments have been focused on the supply of water to existing entitlement holders not on anticipating future demand. As it is, this focus is taking a great deal of their time and effort to manage.

The system in NSW is fully allocated, meaning no new entitlements are being issued. The framework at present is trying to accommodate the change in usage of water as the environmental entitlement increases and the productive entitlement decreases. In other words, if the environment requires more water and is prepared to pay for the entitlements, then they are the ones increasing their share of the available water. Similarly, if new mining operations were to be opened, the increased demand would see a transfer of water entitlement from agricultural production to mining.

If we want to create new entitlements or for that matter increase reliability of existing entitlement, current users would have to be willing to pay for the infrastructure which increases our ability to capture and store water. By increasing our capture and storage we could maintain higher allocations for longer periods, but unless major projects are undertaken to greatly increase storage, we will not be increasing the entitlement pool.

Current usage is being tracked via meters and river gauges, but this information is not going into any models which could assist us in understanding what the outcome is from factors such as climate variability, transfer of entitlement away from productive use or pressure from increasing population. With this type of work not been undertaken, we have no way of understanding what the future holds.

When searching for predictive modelling which is being done around the world, there is very little information available. There does not appear to be a good model or sufficient input data to determine if a “Worlds Best Practice” has been established.

Conditions and water resources here are different to those in other locations around the world, so to utilise other predictive modelling would be extremely difficult.

As a matter of urgency, the departments must start work on developing a predictive model for water use in NSW.

LAKE MEJUM

A CASE TO GOVERNMENT TO FUND THE DEVELOPMENT

OF A WATER STORAGE AND RECREATIONAL FACILITY

Submitted by

The Shires of
Balranald, Carrathool, Griffith, Hay, Jerilderie,
Leeton, Murrumbidgee, Narrandera and Urana

The County Councils of
Murrumbidgee and Southern Riverina

The Lowbidgee League

The Rice Grower's Association of Australia

Coordinated by

McGowan Associates
Albury and Hay

MAY 1984

CONTENTS

SUMMARY AND CONCLUSIONS

The Mejum Lakes comprise a series of natural depressions just north of the Murrumbidgee River at Narrandera. For many years consideration has been given to using the lakes as a storage for surplus river water. The Average Annual Flow in the Murrumbidgee River at Wagga Wagga is 4 400 000 megalitres (Ml) whereas the Average Annual Supply obtainable for the system under the present Volumetric Allocation Scheme is 2 500 000 Ml per year.

Local pressure to create a storage at Lake Mejum has arisen from a number of different community groups. Farmer organisations have requested both an increased supply of irrigation water and a means of more efficiently using the present water resources available. Recreational interests point out that the area is inadequately served for water based sports when compared with other areas of the state despite the availabilty of river water. Those involved with tourist promotion claim that the area needs a focal point to attract tourists from outside the region. The drought of 1982-83 has impressed on all how dependent the area is on conserved water and especially the importance of adequate water supplies in securing employment opportunities.

In response to these various local pressures the Shires and County Councils of the region and various local organisations coordinated by the Murrumbidgee Valley User's Association decided to put a case to government to fund the implementation of the Lake Mejum scheme. A representative committee has prepared this report with the help of consultants.

The report aims to marshal arguments in favour of the scheme with a view to persuading government to allot a high priority to the project. The scope of the report is not to produce a new study but to consolidate previous work and local knowledge into a convincing case to implement the current proposal which has wide community support.

The key features of the proposed scheme are the construction of a storage at Lake Coolah of 450 000 Ml of which 50 000 Ml would be retained throughout the summer as a recreational reserve at a cost of $36 million. The Mejum Swamp would be a wildlife reserve and appropriate facilities for recreation and tourism would be developed.

Benefits would flow to many sectors of the community; irrigation farmers would have more water available and because the storage would be close to the farms this would enable more efficient use of all available irrigation water; the large local population which is now poorly served with areas for water recreation would have facilities comparable with other areas; tourism would bring new development to the area and overall job opportunities could increase.

The source of funds to implement this project is a matter for government decision. The difficult decision of who pays for what will require lengthy discussion. This will be a demanding exercise because of the multipurpose nature of the project and the wide dispersion of benefits both geographically and to different groups within the community.

The committee believes the project meets all the requirements of current government policy to achieve the highest priority. It is directed to improve the management of existing supplies and reduce waste of the limited quantity of water currently available. It is a low cost project when compared with alternatives of a major new headworks storage. With an internal rate of return of 13 percent it compares favourably with other investments of public funds.

1. BACKGROUND

The benefits which flow to people living in inland New South Wales as a result of water conservation become more clear with each passing year. The drought which ended in 1983 showed that many large towns in irrigation areas as well as their dependent rural population were not only insulated from the effects of natural disaster but maintained business and employment levels which helped the whole state.

The benefits of irrigation have long been recognised. However the drought of 1982-83 has emphasised the importance of secondary benefits to towns in irrigation areas. Because of the business generated by secure irrigation production as well as the recreation and tourism that has been attracted to the larger water storages, towns adjacent to these facilities were able to maintain high employment levels while other inland areas were severely depressed.

The growing demand for water based recreational locations plus the secure demand created for farm inputs provided river areas with a cushion against the drought. These activities provided work for a large part of the population and enabled even those affected to recover more quickly. The recreational facilities provided in the neighbourhood of Burrinjuck, Lake Wyangala, Lake Hume and Lake Mulwala are now creating a community interest in and justification for water conservation that in a previous generation was centred almost exclusively on the irrigated land which was fed by the storages. Unfortunately the benefits of such storages are geographically remote for much of the population of southern NSW and the smaller reserves such as Lake Wyangan near Griffith (240 ha), Lake Albert in Wagga Wagga (104 ha), and Lake Talbot in Narrandera (40 ha) are quite inadequate for the demands placed on them. For example Lake Talbot has a maximum permissable number of six power boats on the water at any one time. Other towns are deprived of even these restricted recreational opportunities which are so taken for granted by the majority of Australians living in the seaboard capital cities with their easily accessible beaches.

The benefits of water conservation are enjoyed by wide sections of the community; many perceive the greatest benefit being derived from the recreational oppportunities afforded by water storages; others appreciate more the security of town water supplies made possible by river regulation. Those concerned more with affairs of state see the widespread regional benefits arising from business and employment opportunities which are secured by the economic strength of the farming industries based on irrigation which make the other benefits possible. From a national viewpoint the overall economy benefits by increased exports of commodities in which Australia has a comparative advantage over its competitors, the circulation throughout the community of the large income derived from these crops and the very significant amount of tax generated by this prosperity.

In the Murrumbidgee Valley the main irrigation areas (the Murrumbidgee Irrigation Area [MIA], centred on Griffith and Leeton, the Coleambally Irrigation Area [CIA], the Hay Irrigation Area) and the river pumpers have now developed their enterprises to the stage where the regulated flow of the river is virtually fully committed. In fact, there are competing forces vying to use the available water. While recognising the value of in-stream and down-stream uses of water the present position is that although the Average Annual Flow in the river at Wagga Wagga is 4 400 000 Ml, the Average Annual Supply obtainable from the system under the present Volumetric Allocation Scheme is 2 500 000 Ml with operational losses running at approximately 300 000 Ml per year. The proposal to store water in the Lake Mejum depression is based on the concept of storing and using water which would be diverted to the lake from surplus Murrumbidgee River flows. Uncontrolled flows arise from spills from the existing storages of Blowering and Burrinjuck, the significant contribution of tributaries, for example the Tarcutta Creek, which flows into the Murrumbidgee below the existing storages on the upper reaches of the river and from irrigation cut-backs.

The existence of a large body of water in close proximity to the centre of irrigation demand will significantly increase the efficiency of utilisation of water available from the Murrumbidgee. Because the main storages in the headwaters of the river are many days flow away from the irrigated areas it is impossible to control with accuracy the release of the desired quantity of water as this is varied from day to day by changing demand (irrigation cut backs) and supply (tributary flows). The recent construction of the small en route storage of Tom Bullen near Darlington Point is the best proof of this need. Though this storage capacity is only 11 000 megalitres (Ml) it is estimated that this small facility saved 80 000 Ml in the 1982-83 season. With adequate storage close to the irrigated areas as would be supplied by Lake Mejum efficiency of use would improve significantly.

According to the Water Resources Commission (WRC) 1/, "The main purpose of the Lake Mejum storage is to provide an improvement in the regulation of the flow of the Murrumbidgee River in order to augment the volume of water available for irrigation purposes". The Commission however, also recognises the great importance attached to the preservation of environmental quality and social welfare, integral components of the proposed storage.

The concept of storing this surplus water in the large natural depression just north of the Murrumbidgee River at Narrandera has been discussed for many years and has been the subject of detailed feasibility 2/ and environmental 3/ studies.

1/ Lake Mejum Storage Proposals, December 1980, Water Resource Commission, P.2.

2/ Water Resources Commission Proposal, 1980, identified three project options.

3/ The Lake Mejum Storage Proposal Environmental Study Report, 1977, Rankine & Hill, Consulting Engineers for the Water Resource Commission.

As a result of these studies and the subsequent consideration of the various options available for the construction of storages of different sizes and their associated social and environmental impact, there has been substantial community discussion. As a result of this process, agreement has now been reached regarding the preferred and acceptable nature of development in the area. The recommended option for development is shown on the attached plan (see Map 2) but it is expected that this could be amended as ongoing studies, including this report, are developed and accepted. A summary of the scheme is set out in the attached table, Appendix 4, with costs expressed in December 1983 values.

The key features of the present proposal are that a storage basin with capacity of 450 000 Ml will be constructed at Lake Coolah; a combined inlet/outlet canal, 9 kilometres in length will be constructed from Bundidgerry Creek to the storage and water will be pumped an average of 18 metres lift. In order to maximise the benefits of the scheme and because of the evaporation factors, the water from Lake Coolah which will be stored mainly during late winter and spring, will be released to provide for the demands of irrigators as soon as possible. This will conserve the waters stored in the headwater dams for later use and allow space in Lake Coolah for the capture of surplus flows as they arise. For recreational purposes a reserve of 50 000 Ml will be held in the lake for the whole summer period and this reserve, together with the adjoining Mejum Swamp, a wildlife breeding ground, will present a major recreational area with a variety of water-based interests to service the region.

Because of the complexity of the various developmental options considered, the desirability of community participation, the need to balance community interests in irrigation development, recreational pursuits, environmental issues, wildlife preservation and the social disturbance associated with property acquisition, progress towards an agreed development plan has been slow. It is also recognised that in the step-by-step process being followed by state government, local government and the various community interests involved, there are still many issues to be discussed and resolved. For example, the Minister's recent commitment to a further environmental impact study building on the 1977 environmental study has become necessary because the nature of the development has changed and new issues have arisen. The first study emphasised the importance of Mejum Swamp as a wildlife reserve and this has led to the retention of this area for this purpose and its exclusion from inundation as a water storage. Other issues are still to be resolved such as whether the works to drain Mejum Swamp should be utilised to improve it as a wildlife reserve by allowing Lake Coolah waters to supplement it at appropriate times. Despite the foreseen questions, which must still be resolved, local government is now fully supportive of the decision to move one step closer to development of the scheme but the major consideration now is a funding commitment for implementation.

The scheme has for many years been supported, in principle, by the WRC although the earlier priority for implementation enjoyed by the project was not upheld because of the procedures necessary to obtain community agreement in the choice of an acceptable option. The Commissions' position is probably best summarised in the following statement:

"Commitment of the regulated flow now available in the Murrumbidgee River system has reached the stage at which plans need to be prepared for the development of the next major storage on the system if appreciable further irrigation is to be possible". 4/

"The decision to intensify investigation of the Lake Mejum storage was made after examination of a number of other alternatives available to supplement the supply available in the Murrumbidgee system. Earlier work included consideration of alternative headwater storages....." and "consideration of pumping from the groundwater reservoir". 5/

The support of the Government of New South Wales has been expressed by a number of Ministers on various occasions. On 27 March 1981, Mr Lin Gordon, Minister for Lands, Forests and Water Resources stated in Narrandera: "It is the Government's intention to press ahead with the Lake Mejum Scheme. A good deal of work and planning has already gone into the Lake Mejum Project ..... now we are going to do something about it ..... the New South Wales Government gives it a very high priority. We will be stressing to the Federal Government the economic and other advantages of this scheme ..... We hope that the feasibility studies for the Lake Mejum Project will be completed within the next year, so that normal design and environmental procedures can be followed and construction will be started as soon as possible".

4/ Water Resources Commission Report, December 1980, P.2.

5/ Water Resources Commission Report, December 1980, P.3.

2. BENEFITS FROM IRRIGATION

2.1 Water Supply

Irrigation benefits from increased water availability are more easily quantified, particularly in dollar terms, than benefits such as those associated with recreation or the environment. The development of the irrigation areas drawing water from the Murrumbidgee River (by far the largest areas in New South Wales) has been so successful over the years that the demand for water continues to increase. The Murrumbidgee Valley Water User's Association has taken the lead in coordinating and assessing the water needs to ensure ongoing development of the area. In this regard they maintain close liaison with the Water Commission and local government authorities.

The irrigation benefits directly associated with Lake Mejum are many and diverse. By diverting into Lake Mejum water which would not otherwise be used, more irrigation water is available in the whole system. This in turn has a variety of benefits. For existing irrigators it could enable them to increase the output of their current enterprises and it provides security in making the decision to intensify. The availability of water at critical stages of the crop's growth is all important in achieving the potential yield; if supply is not available when needed much of the other expenditure on the crop is less effective than it could be and income is significantly less. Since all other costs of production have been covered and the infrastructural support is already in existence, the availability of water at the margin of production can be the most profitable. By securing this availability decisions can be made not only to increase overall production by planting a larger area but also the quality and efficiency of water utilisation on the farm is enhanced so that each hectare will produce more (Appendix 2, Table 4 [Assessment of Water Use Efficiency in Irrigation, WRC Report, November 1983, Annex 3]).

Another benefit arising from additional water is the potential to expand the area which can be irrigated. At this stage it is unnecessary to forecast exact allocations to individual water users since there is already a demand considerably in excess of the extra water which will be available. Appendix 3 sets out in some detail the various localities and industries which have expressed dissatisfaction with their present low allocations or their need for additional water supplies and areas currently inadequately served which could be profitably expanded if water were available. The demand for the increased supplies is well documented and since allocation decisions will be difficult, it is inappropriate to consider these details until the scheme is under way, as long as decision-makers are sure that adequate demand exists. This question is not in doubt.

2.2 Water Management

Additional benefits arise from improvements in water management. En route water storages, that is those in addition to the major headwater storages of Burrinjuck and Blowering (Berembed, Yanco, Googelderie, Maude and Redbank Weirs and Tom Bullen storage) significantly improve the system's capability to deliver water as required to irrigators. Lake Mejum, with its large storage capacity and outlet channel, could provide water close at hand for quick release to the MIA, CIA and downstream private pumpers in localities such as Narrandera, Darlington Point, Yanco Creek, Carrathool, Hay, Maude and Balranald.

2.3 Water Use and Value

In order to calculate the financial benefits arising from the increased supply of available water, it is necessary to consider the use to which the water may be put. In recent years the WRC has received from a variety of water user groups (Ricegrowers Association, Riverina Coarse Grain Association, Murrumbidgee Valley Licensed Pumper's Association) requests for both additional water and a greater surety of supply to existing irrigators. It is this pressure for supplies which is now the main motivating force for the construction of the storage. With the increased demand, the Commission has introduced a system of volumetric allocations for different users. Thus the licensed pumpers have been allocated 6 Ml per hectare whereas they have requested 9 Ml per hectare. Without considering the justification for competing claims, it need only be pointed out that currently licences to licensed pumpers cover 104 000 hectares and even to provide the requested increase in allocation from 6 to 9 Ml for this area would require more than the total regulated flow estimated to become available from Lake Mejum (see Appendix 1).

With regard to the value of water, Appendix 2 sets out details of "high" (the top few percent) and "low" efficiency irrigated farms in the Murrumbidgee Valley. It also calculates gross margins per hectare and per Ml for typical enterprises - calrose rice, maize, wheat and sheep. The figures indicate the importance of 'high' water availability and the influence this has on the ultimate value of water. The tables indicate also the variability of value between enterprises and the standard of efficiency. There is no such thing as a 'typical' farm and hence the weighting to be put on the various factors is a matter of judgement. Further study would enable a more accurate estimation of water value in different categories but it is suggested that for this exercise a figure of $20.00 per Ml is appropriate. This approximates the figure of $18.80 used by the WRC in its 1980 study.

3. BENEFITS FROM RECREATION

There is no doubt that the Australian population, whenever given a choice of recreational locations, prefers a water-based situation.

By far the greater proportion of urban based populations have access to good beaches which have made a marked contribution to the Australian character. For the vast number of Australians living inland where the attraction of the sea is not available, the limited water based resorts have been the undoubted attraction, not only for families as camping and picnic sites for weekend or holiday outings, but also for the increasing proportion of Australia's population represented by the younger age groups, adolescents and young adults, who pursue whenever possible outdoor recreational pursuits oriented to enjoyment of water based recreation.

In the inland areas of New South Wales, there are understandably very few permanent lakes which can be patronised for recreation but those that do exist are well utilised and those nearer the major centres of population are considered to be fully utilised, for example Lake Talbot at Narrandera, Lake Albert at Wagga Wagga and Lake Wyangan at Griffith. Water Commission storages further removed from the inland population such as Lake Wyangala and Lake Blowering are becoming popular. On the Murray, the storages at Lake Hume and Lake Mulwala, which are shared with Victoria are utilised more by the higher densities of population represented in that State and have long been major tourist attractions. In inland Victoria, the Water Commission storages such as Lake Eildon and Lake Eppalock are not only drawcards for the rural population but also attract large numbers of metropolitan users who prefer the environment and the advantages of freshwater storages.

It seems that the popularity of inland water storages need not be laboured, since it is universally accepted that their appeal is to all groups and all ages. A previous study of Lake Mejum estimated a long term yearly figure of approximately 200 000 visits for recreation. This study supports this estimate, which is comparable to a Victorian storage such as Lake Eppalock which caters for up to 7000 visitors per day.

From a national viewpoint, the population of the inland has far fewer recreational opportunities than is available to those living on the coast or in the major urban centres. Since the Lake Mejum Scheme has the potential to provide recreational facilities for a section of the population which is currently severely disadvantaged in this area, it appears appropriate that as part of a national program, due attention should be given to these recreational benefits.

Map 4 shows the main centres of population within recreational driving distance of Lake Mejum. Population within 50 miles is 56 250 with Narrandera 7650, Leeton 11 300 and Griffith 21 350 being the main centres. Within 100 miles but excluding Victoria 6/ the population is 228 850.

6/ A survey of the Tourist Industry in the Riverina Region of NSW, G A Lawrence, Riverina College of Advanced Education, 1976. Victorian visitors (normal residence x destination) equalled both Sydney and other NSW visitors, hence must be given some weight.

However, this includes Albury and Corowa which are served by excellent facilities for water-based recreation at Lake Hume and Lake Mulwala. Burrinjuck, Blowering and Lake Cargelligo are all outside the 100 mile radius. It seems therefore that the Riverina is Australia's largest concentration of population without a convenient water-based recreation location despite the fact that it is drained by one of the biggest and most reliable rivers in the nation. The new lake will be about 8 kilometres from Narrandera and 12 kilometres from Leeton and hence is in an ideal location to serve these areas.

A number of methodologies are used to try and quantify the value of recreational benefits. Two typical techniques have been to estimate the cost which a person is prepared to incur in travelling to the resort and allocate this cost as a benefit of the resort itself. The alternative method has been to estimate the expenditure which a user is prepared to incur on water based recreational equipment, eg. boat, sailboard, fishing gear, swimming gear etc, and to equate this total expenditure with the benefit attributable to the recreational resort. Despite the justification which can be argued for these methods of estimating the dollar value of resources, we are aware that the methods of evaluation are far from ideal even though the best or most practicable available (see Appendix 5). Using these methods a figure of $7.50 per visit is estimated.

In 1979, a Recreation Tourist Study 7/ of Lake Mejum involving a questionnaire and interview technique approach was undertaken to quantify the demand for these facilities. The questionnaire was designed to generate source data on the expected benefits of recreation/tourism. It was distributed to Aquatic Clubs, Local Government Authorities and Chambers of Commerce in the towns of Narrandera, Griffith, Leeton and Wagga. Analysis of data provided by responses to the questionnaires enabled an aggregated recreational benefit in monetary terms to be derived. The recreational benefits include sailing, powerboating, water skiing, canoeing, fishing, swimming, as well as passive recreational pursuits such as camping, picnicking and bird watching.

Benefits would accrue not only to residents of Narrandera and regional sporting bodies but also to tourists who would seek to utilise the recreation and accommodation facilities which will follow once the tourist potential of the Scheme is recognised.

Widespread community participation has expressed the need to plan and incorporate into the design of the scheme full recreational facilities.

Previous studies of both the Riverina Area and other major storages clearly indicate a dual requirement to satisfy visitors. Firstly there must be good access to a number of areas from which water based activities can be conducted and secondly there must be an extensive opportunity for passive enjoyment both by restfully observing the water and by a scenic drive which will encompass a variety of water aspects.

7/ Water Resources Commission Lake Mejum Storage Proposal, P.11-12.

The present plan caters for two major access areas for water based sports and activities. A preliminary survey indicates that the contour of the sites will allow vehicle access, good viewing of the basic 50 000 Ml water storage and adequate access to water without long travel over "mud flats". These sites also have adequate room to develop tourist facilities, caravan parks etc. as the need develops. The environmental studies now due to be undertaken will survey these sites in detail to determine their suitability for recreation. Points for consideration could include: impact on recreation of steep shore resulting from substantial variations in levels; provision and suitability of areas for swimming, boating etc; usage of foreshore land for various purposes and the relationship bewteen water area and shoreline with recreation supply standards. Soil studies should determine the dispersive nature of the soils at the selected sites to indicate whether the clay and sand fractions will separate out to provide a measure of sandy beaches or whether other improvements such as sand transportation would be desirable to raise the facilities to an acceptable level.

To cater for the likely demands of a scenic drive the location is ideally suited to combine the attractiveness of the deeper water of the major storage in Lake Coolah with the shallow water wildlife reserve area of Lake Mejum. The drive from Narrandera now proceeds through a Murray Pine forest for several kilometres which then thins out to a very pleasant Murray Pine savannah extending onto the sand ridge separating Lake Coolah from Mejum Swamp. Altogether it is a most attractive environment which with little expense can be made quite unique as regards scenic attraction. The situation of lakes and proposed embankments would facilitate a scenic drive adjacent to the water side and encircling both bodies of water so that a figure-eight route would enable the visitor to enjoy the varied aspects of water and wildlife scenery. Appropriate tree, shrub and grass plantings will over time develop the scenic attractiveness of this diverse area and bring together in close approximation the unique attraction of Riverina waters - the still water with its red gum dominant vegetation and the fluctuating reedy shallows so suitable for wildfowl habitat.

The Mejum Swamp is considered somewhat unique in that it is a river redgum swamp not associated with a river or creek and this in turn provides excellent waterbird habitat, providing both breeding and feeding areas and overall, considered a most valuable regional wetland area.

Another survey 8/ of the tourist industry in the Riverina concluded that the 'scenery/countryside' was the feature most enjoyed by visitors, 21 percent compared with 'tourist attractions' at 7 percent. A feature of the survey was the absence of any single feature in the Riverina to which tourists could specifically relate despite the Riverina's overall tourist attraction. This absence is an important reason for the region's lack of appeal when compared with other regions of the state. This survey concludes "Just as water is a scarce resouce in the Riverina for farming activities, it is also a scarce resource for recreational and tourist activities. In the United States a great number of inland lakes have been developed as multipurpose recreational/tourist attractions as well as for the provision

---

8/ A Survey of the Tourist Industry in the Riverina Region of NSW, G A Lawrence, Riverina College of Advanced Education, 1976.

of irrigation water. This sort of development could be achieved in both the Tumut and Narrandera areas". It is also recommended "...that developments begin on Lake Blowering as soon as possible, that plans be made for large areas of Lake Mejum (when constructed) to be used for recreational/holiday purposes.....The Griffith/Leeton area is destined for increased tourist activity in future years if present trends continue". There is every reason to support these recommendations and to conclude that the establishment of a major tourist feature such as the Lake Mejum Recreation and Wildlife Reserve would be the most efficient single investment to advance tourism in the Riverina and act as a drawcard to attract potential tourists from other areas of NSW and the ACT.

4. ENVIRONMENTAL BENEFITS

One of the disadvantages of earlier plans for a Lake Mejum Scheme was that by flooding the swamp a unique feature of the landscape would be destroyed. Previous environmental studies have shown that the Mejum Swamp provides an important regional habitat for waterbirds in respect of both feeding and breeding. The proposed scheme leaves Mejum Swamp in its original condition. One of the effects of irrigation in the Murrumbidgee Valley has been to cause a change to the wildlife habitat in billabongs associated with the river system. The Commission is investigating the feasibility and likely benefits of artificially prolonging flooding of the billabong system to create a flooding pattern more similar to the natural system which would have prevailed prior to regulation of flows in the Murrumbidgee River System. While Mejum swamp in its present condition provides excellent habitat for waterbirds it is possible this situation may be enhanced by a system of artificial flooding which would fit in well with the overall plan for the two interconnected water areas.

With regard to fish life, the New South Wales Inland Fisheries has expressed interest in stocking a water storage in the vicinity of its Research Station at Narrandera. It is anticipated that there will be no significant detrimental effects to other fauna.

The Minister has announced that an Environmental Impact Study will be conducted and the Commission has initiated work on relevant water quality aspects. Water quality data already gathered indicates that unless properly managed, the waters of the proposed storage could be potentially eutrophic and might result in undesirable environmental effects including algal blooms and fish kills. The Commission will undertake a water management program taking into account the likelihood of eutrophication.

If additional areas of shallow stagnant water and swampy ground are created as the storage area drains, these may provide potential breeding areas for arbo-viral disease carriers such as mosquitoes. However, it is planned that drains would be constructed to allow residual detached swampy ground to be drained towards the central retention recreational area. A pipe through the embankment separating Lake Coolah from Mejum Swamp would allow water depth to be controlled in Mejum Swamp and retain its value as a wildlife habitat.

5. QUALITY OF LIFE BENEFITS

Apart from the general improvement to quality of life by improving leisure opportunities County Council support arises primarily because of the prospective benefit and security which the scheme offers to town and rural water supplies. These requirements are expected to increase as population growth occurs and besides affording security in times of drought for the present population the scheme will enable planning for future population growth to proceed with confidence.

Indirectly the improved availability of water for river pumpers will assist in overcoming the conflict which presently exists between the Council and landholders in situations where the Council is desirous of establishing source bores for town supplies on lands adjacent to the river. Because the available surface waters are fully committed these landholders are unable to obtain pumping licenses to extract water from the river and are forced to employ underground resources to thus compete with town supplies which are drawn from these same resources.

The proposal would require acquisition of all or part of 10 properties. The Commission will either acquire landholdings on which viability has been lost or provide access to severed holdings which remain viable. Consideration is also being given to landholders' requests for access to the inlet-outlet canals for water supplies.

Inundated arterial roads would be relocated. It is not expected that the scheme will cause increased travelling distances or stock transportation costs or disrupt existing social contacts.

The Commission will engage an archaeologist to undertake a survey for Aboriginal artifacts in the area and will report any findings to the National Parks and Wildlife Service for a decision on the appropriate course of action.

6. REGIONAL BUSINESS AND EMPLOYMENT BENEFITS

Primary benefits arise owing to the stimulation to local commerce in the course of the construction of the new works. It is recognised that this is a relatively small and short term benefit but to the extent that a significant part of construction costs remain in the immediate area, they are a benefit to local towns. The significant benefit to business and employment however is the flow on from the irrigation, recreation and tourist development which the storage makes possible.

The Murrumbidgee Irrigation Area, with its towns of Griffith and Leeton, is one of the prime examples in Australia of how a wisely planned and well developed irrigation system has without doubt created widespread employment opportunities and is a practical example of efficient decentralisation. The success of the area and the large population which it supports is the best argument which can be put forward to support further development. Without the job opportunities which will be created by further irrigation development, there will be increased demands for welfare payments.

Although it is accepted that the prime beneficiaries are the irrigation farmers who sell the increased produce, the flow-on or multiplier effect must also be considered. Associated with irrigation are the industries supplying farm inputs; machinery, chemicals, services etc. which are an integral and essential component of production and a significant employer. Associated with recreation and development (in addition to the direct benefits of accommodation, food etc.) are the indirect benefits flowing to outlets such as cafes and milk bars, garages and service stations, taxis, aircraft maintenance, boat builders, sports goods and camping equipment, travel agencies, bus services, museum galleries, sporting and social clubs etc.

Some economists do not count any multiplier benefits while others calculate a factor by which primary benefits are adjusted. In the WRC Study of 1980 a multiplier benefit of 1.2 was allocated to irrigation and 1.4 to recreation and tourism when assessing the regional impact of the scheme. In the study "The Role of Tourism and Recreation in the Albury/Wodonga Growth Centre", carried out by PA Management Consultants for the Department of Tourism and Recreation in 1974, an extensive survey was carried out to estimate the multiplier effect in a comparable environment. It was concluded (page 295) that "for each dollar spent by tourists in hotels or motels in Albury/Wodonga, 36 percent generates secondary spending in Melbourne or Sydney; for each dollar spent in these establishments in the total area studied 44 percent leaks out of the area immediately. Since there are other leakages as well (taxes, savings, secondary spending on goods and services from outside the area) the tourist multiplier is probably of quite modest magnitude, say between 1.2 and 1.4". It is beyond the scope of this present report to carry out the detailed investigation necessary to come up with a more accurate figure. Since the WRC report has already decided to use multipliers of 1.2 and 1.4 for Lake Mejum for assessment of regional impact these figures are accepted until further information with more local content becomes available.

7. ECONOMIC ANALYSIS

Because it is relatively easy to assign a dollar value to the benefits which arise from irrigation it has become accepted practice for potential irrigation investment to be subjected to cost benefit or net present benefit analysis. It is a straight forward exercise to identify project costs (land acquisition, road reconstruction, engineering works etc.) and then estimate the extra benefits that are expected to be generated by the application of additional irrigation. Because costs are incurred early in the project's life and benefits arise later it is necessary to apply an appropriate rate of interest to the cash flow of each year. The real interest rate which equates present value of costs with benefits is defined as the internal rate of return.

For recreation it is far more difficult to assign a dollar value to benefits. However, in order to assist in decision making it has become accepted that wherever possible estimates of monetary values should be made even for benefits which would not normally be expressed in dollar terms. The available methodologies in the bases for these calculations have been dealt with in their appropriate sections.

It is assumed that the benefits, though of differing origins, will be stable once the construction period is over. Benefits are summarised as:

-	Irrigation	208 000 Ml per year @ $20.00 = $4 160 000
-	Recreation	200 000 visits per year @ $7.50 = $1 500 000
-	Regional Multiplier providing business and employment	(0.2 for irrigation and 0.4 for recreation) = $1 432 000
-	Total Yearly Benefit	= $7 092 000

With regard to capital costs these have been estimated (after making allowances for land acquisition, fencing, road construction, earthmoving and engineering works, recreational facilities) at $36 million. Annual costs are operation and maintenance, estimated at $275 000 and electricity for pumping estimated at $1.1 million per year (see Appendix 4 9/). There is thus an annual cost of $1.375 million which when deducted from the annual benefit leaves a net annual benefit of $5.717 million.

It is assumed that capital costs will be equally spread over a three year construction period and that no benefits will occur until construction is completed but thereafter will remain stable at the above figures. Using these assumptions the discounted present value of costs and benefits are equal (over a life of 30 years) if a discount rate of 13.5 percent is applied to both, ie. the financial rate of return is 13.5 percent.

9/ WRC estimates at December 1983.

To arrive at this figure a number of assumptions have been made and set out in the text and the appendices. However, some of these assumptions may be wrong and therefore it is wise to see how sensitive the profitability of the scheme is to some key assumptions. The fact that the scheme relies on electricity for pumping concerns many local people being aware of the very steep increases in electricity charges in recent years.

In the above calculations electricity charges have been escalated from a 1980 estimate of $620 000 to $1 100 000 (an increase of 77 percent compared will 31 percent in other costs). However, if electricity costs were again to take a major leap and increase by say, double the level of other costs half way through the estimated life of 30 years, what effect would this have? The return would reduce from 13.5 percent to 13 percent. On the other hand if the life of the capital works is considered to be 50 years not 30 years the original figure rises from 13.5 percent to 13.9 percent and with the electricity price doubling then the return would be 13.4 percent.

Another concern expressed is that if there is a severe drought, say 1 year in 15, the waters of Lake Coolah will be unavailable for recreation and hence, there would be no recreation benefit. This would reduce the benefit from 13.5 percent to 13.3 percent. However the loss of recreational benefits would to an extent be offset by the irrigation benefits derived from the water released.

APPENDIXES

1. VOLUMETRIC WATER ALLOCATION
2. CROP/ENTERPRISE GROSS MARGINS
3. POTENTIAL WATER USE
4. KEY TABLES - FEATURES AND COSTS OF THE SCHEME
5. EVALUATION OF RECREATIONAL BENEFITS

VOLUMETRIC WATER ALLOCATION - MURRUMBIDGEE VALLEY

		Ml/Year
1.	Fixed Commitments	280 000
2.	Losses	500 000
3.	Irrigation Commitments	
	(i) Permanent Plantings	157 000
	(ii) Licensed Irrigation	
	Other than Yanco, Colombo and Billabong Creeks System	385 000
	Yanco, Colombo and Billabong Creeks System	163 000
	(iii) Murrumbidgee Irrigation Areas and Associated Districts	1 059 000
	(iv) Coleambally Irrigation Area	620 000
	(v) Hay Irrigation Area and Gumly Irrigation District	8 000
	(v) Reserve for resolution of anomalies	50 000
4.	Unallocated Contingency Reserve	130 000
	TOTAL	3 362 000

KEY TABLES - FEATURES AND COSTS OF THE SCHEME

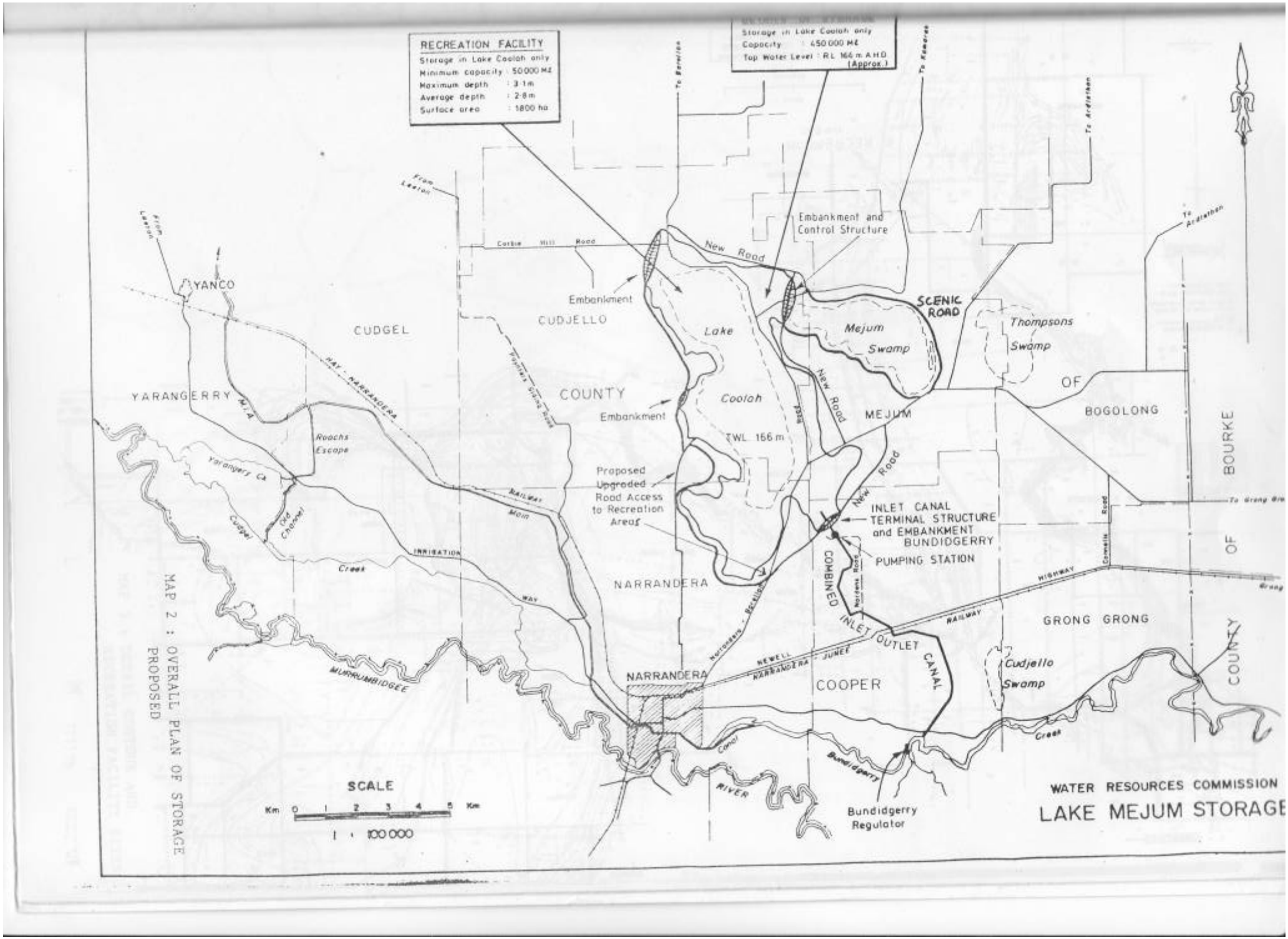
PHYSICAL DETAILS OF THE SCHEME

Capital Cost (December 1983 Money)	$35.8 million
Construction Time	3 years
Top Water Level (AHD)	166 m (approx.)
Storage Capacity - Lake Coolah	450 000 Ml 1/
Surface Area (at top water level)	3700 ha
Addition to Average Annual Supply (Yield)	208 000 Ml
Average Pumping Lift (metres)	18.2
Maximum Pumping Lift (metres)	21.8
Average Annual Electricity Energy Consumption (kilowatt-hours)	20.4 million
Peak Electrical Power Requirement (megawatts)	9.0
Combined Inlet/Outlet - Capacity	2800 Ml/day
- Length	9 km

Recreation Facility

Location	Lake Coolah
Minimum pool level (AHD)	153.20 m
Maximum pool level (AHD)	166 m (approx.)
Minimum Volume	50 000 Ml (min)
Minimum Surface Area	1800 ha
Maximum depth at minimum pool level	3.1 m
Average depth	2.8 m
Water Level Fluctuation	12.8 m

1/ Ml = megalitres = 1 000 000 litres = 0.8 ac. ft. (approx.)


RECREATION FACILITY
Storage in Lake Coolah only
Minimum capacity : 50000 ML
Maximum depth : 3·1 m
Average depth : 2·8 m
Surface area : 1800 ha
Storage in Lake Coolah only
Capacity : 450 000 ML
Top Water Level : RL 166 m AHD (Approx.)
To Barellan
To Kamarah
To Ardlethan
From Leeton
Corbie Hill Road
New Road
Embankment and Control Structure
Embankment
YANCO
CUDGEL
CUDJELLO
Lake
Coolah
Mejum Swamp
SCENIC ROAD
Thompsons Swamp
COUNTY
OF
BOGOLONG
MEJUM
BOURKE
YARANGERRY N.P.A.
HAY - NARRANDERA
Roachs Escape
Yarangery Ck
Old Channel
Cudgel
Creek
Embankment
TWL 166 m
Proposed Upgraded Road Access to Recreation Areas
RAILWAY
Main
IRRIGATION
WAY
INLET CANAL TERMINAL STRUCTURE and EMBANKMENT
BUNDIDGERRY
PUMPING STATION
COMBINED INLET OUTLET CANAL
HIGHWAY
Grong Grong
NARRANDERA
NEWELL
NARRANDERA - JUNEE
COOPER
Cudjello Swamp
GRONG GRONG
COUNTY
MURRUMBIDGEE
Canal
RIVER
Bundidgerry
Bundidgerry Regulator
SCALE
Km 0 1 2 3 4 5 Km
1 : 100 000
MAP 2 : OVERALL PLAN OF STORAGE PROPOSED
WATER RESOURCES COMMISSION
LAKE MEJUM STORAGE