Australian Academy of Technological Sciences and Engineering (ATSE)

DAMS AND THEIR USE FOR WATER MANAGEMENT IN AUSTRALIA

A submission by the

Australian Academy of Technological Sciences and Engineering (ATSE)

to the

Coalition Dams and Water Management Task Force

27 May 2011

Australian Academy of Technological Sciences and Engineering

Submission to the Coalition Dams and Water Management Task Group

The Australian Academy of Technological Sciences and Engineering[1] (ATSE) is pleased to respond to the Coalition Dams and Water Management Task Force, noting that you are particularly looking at dams

- As effective forms of water storage for general consumption
- For food production and for environmental flows
- As flood mitigation infrastructure, and
- Their role in low-emission power generation

Summary

The Academy has identified a number of issues that should be taken into consideration by the Task Group before developing policy recommendations:

- The purpose of the dam – the potential problem of conflicting objectives
- Need to have a catchment management plan
- Possible climate change impacts
- Impact of land use change
- Existing rights
- Market demand
- Power generation
- Pumping costs
- Variability of supply
- Economics
- Food security

Each of these issues is expanded further in this submission

.

[1] The Australian Academy of Technological Sciences and Engineering is an independent body of 800 eminent Australian engineers and applied scientists driving technological solutions for a better Australia.

THE ACADEMY

The **Australian Academy of Technological Sciences and Engineering** (ATSE) is an independent, non-government organisation consisting of some 800 Fellows, promoting the development and adoption of existing and new technologies to improve and sustain Australia, our society and economy. One of four learned Academies, ATSE was founded in 1976 to recognise and promote the achievements of Australian scientists, engineers and technologists. ATSE provides a national forum for discussion and debate of issues critical to Australia's future, especially the impact of technology, science and engineering on our quality of life. Through its Topic Forums, ATSE maintains a strong interest in major policy areas including Energy, Water, Climate Change Impact and Education.

ATSE has a significant record of undertaking policy studies with regard to water. Pertinent recent reviews include:

- Water in the Australian Economy (1999)
- Population Futures (2000)
- Perth's Water Balance - The Way Forward (2002)
- Water Recycling in Australia (2004)
- Review of Water Supply Planning for Australia's non-metropolitan Urban Water Utilities (2007)
- 30/50 – An Australian Population of 30m by 2050 (2007)
- Assessment of Impacts of Climate Change on Australia's Physical Infrastructure (2008)
- The Hidden Costs of Electricity: Externalities of Power Generation in Australia (2009)
- Electricity Generation: Accelerating the Technology (2009)

All of these reports are available from the ATSE website, http://www.atse.org.au/.

ATSE's initiatives in the water arena are led by its **Water Forum**, which promotes and facilitates the contribution of experience and skills of its Fellows to influencing public policy, public education and industry in the development and adoption of optimum technological solutions to Australia's water challenges.

The Australian Academy of Technological Sciences and Engineering (ATSE) convened an International Workshop on *Water and its Interdependencies on the Australian Economy*, in Sydney on 22-23 June 2010, with funding from the Australian Government Department of Innovation, Industry, Science and Research. The Workshop, organised by the ATSE Water Forum Leadership Group, was attended by 50 of Australia's most senior water scientists and policy-makers. It explored the relationships between water and the other key sectors of the Australian economy, in particular energy and agriculture. Challenges included were population change, urban growth and climate change. Speakers identified sensitivity to, and projections for, water demand to the year 2050 and the importance of external drivers, interconnections, and financial investment to support sustainability of their sector. The full report is available for download from the ATSE website.

This submission has been prepared by the Academy's Water Forum, comprising a Leadership Group, a Reference Group drawn from within and outside the Academy and 72 Fellows with an expressed interest in water policy and technology issues, taking account of the outcomes of the International Workshop and other issues.

OBJECTIVE CONSIDERATION OF ALL OPTIONS

It is the view of the Academy that dams and all other forms of water assets/infrastructure should be considered on their merits, taking into account the full suite of economic, environmental and social factors, and not unduly influenced by short-term political considerations. Water infrastructure has a life span of many decades and decisions should be fully informed by appropriate expertise taking full costs and benefits into account. No water resource infrastructure should be laid to one side without objective consideration because of what have been described as pre-determined "policy bans". The Academy is not in a position to suggest where specific dams might be located or removed.

Any consideration of potential dam sites needs to take into account many factors including those discussed in this response. Obvious important factors include the estimated reliable yield, the use and value of the resource retained by the dam, the potential impacts on downstream flows, environmental and diversity impacts, water demand trends and economic value-adding potential, social impacts, and all potential benefits and costs including the issues of energy production and flood mitigation as suggested in your terms of reference.

When all these factors are fully considered, good technical and social assessments are the appropriate means to determine acceptability or otherwise. "Policy bans" or false perceptions of the problems or advantages of dams should not over-ride thorough assessment of all the relevant factors.

STATES OBLIGATIONS UNDER THE INTERGOVERNMENTAL AGREEMENT ON A NATIONAL WATER INITIATIVE

That being said, proposals for new water infrastructure have to be considered in terms of commitments made by the Commonwealth and States/Territories in the Intergovernmental Agreement on a National Water Initiative[2] (NWI), which was signed at the 25 June 2004 Council of Australian Governments meeting. The

[2] http://www.nwc.gov.au/resources/documents/Intergovernmental-Agreement-on-a-national-water-initiative2.pdf

Tasmanian Government joined the Agreement in June 2005 and the Western Australia Government joined in April 2006. The agreement recognises that water is vested in governments that allow other parties to access and use water for a variety of purposes – whether irrigation, industrial use, mining, servicing rural and urban communities, or for amenity values. Decisions about water management involve balancing sets of economic, environmental and other interests. The agreement encompasses clauses on water entitlements, water markets and trading, water pricing, management of environmental water, water accounting, urban water, community partnerships and adjustment, and knowledge and skills. The agreement provides for signatories to provide healthy, safe and reliable water supplies; increase water use efficiency in domestic and commercial settings; encourage the re-use and recycling of wastewater where cost effective; facilitate water trading between and within the urban and rural sectors; and encourage innovation in water supply sourcing, treatment, storage and discharge.

The Academy has identified the following issues that need to be taken into account

THE PURPOSE OF THE DAM – THE POTENTIAL PROBLEM OF CONFLICTING OBJECTIVES

Dams are generally conceived as water storage facilities, though they may also be used as flood control dams – small ones have been widely used in the past as components of soil conservation programs. Where both functions are combined, as in the case of the Wivenhoe Dam, a clear definition of objectives and risks is required. It can be difficult to deal with two inherently conflicting objectives (water conservation and flood control) with one single piece of infrastructure. Flood duration is very important in flood control by dams. During major floods the flood volumes are large compared to reservoir volumes and flood control could be limited if the dam is not nearly empty at the start of the storm event, a circumstance in conflict with a water conservation objective. When designing the dam capacity, average annual rainfall is not a good indicator of high risk storm regions. Rather, a three-day storm duration precipitation map should be plotted. Long duration storm events lead to large floods. The flood volumes over the 2010-11 wet season were generally many times greater than the storage volume of the dams. For example the full storage volume of Queensland's Paradise dam is 300,000ML. The total flow into the dam over a 20 day period was 22 times the full storage volume.

While lowering the water level of dams in anticipation of flood events is often suggested, the capacity of the outlet works is usually very small relative to the storage volume. It would normally take several months to lower the storage level to any significant extent for many dams and weather forecasting is not accurate enough to predict flooding several months beforehand. In the case of Fairbairn Dam, 25 km south-west of Emerald in Central Queensland, it would take 12 months to lower the dam to 50%, even if there were no inflow in that time. In an actual event, the Fairbairn Dam had been at 29% capacity prior to a rain event commencing about 12 January 2008. By 22 January, the water height was 4.5 metres over the spillway and 2700 downstream residents had to be evacuated.

The current Queensland Floods Commission of Enquiry[3] should provide a source of some relevant authoritative material on the performance of water storage dams

[3] http://www.floodcommission.qld.gov.au/

in providing flood mitigation in the recent floods in that region. It should be recognised that rainfall intensities and catchments vary across the country and as stated above, the characteristics of each potential dam and its site should be assessed on their merits. Nevertheless, for large areas of the Queensland region, the technical evidence can be expected to provide valuable information. There will be ample evidence of the impact of Wivenhoe Dam. Also SunWater, as the owner/operator of many dams in Queensland, has provided information and technical comment on the performance of its dams[4].

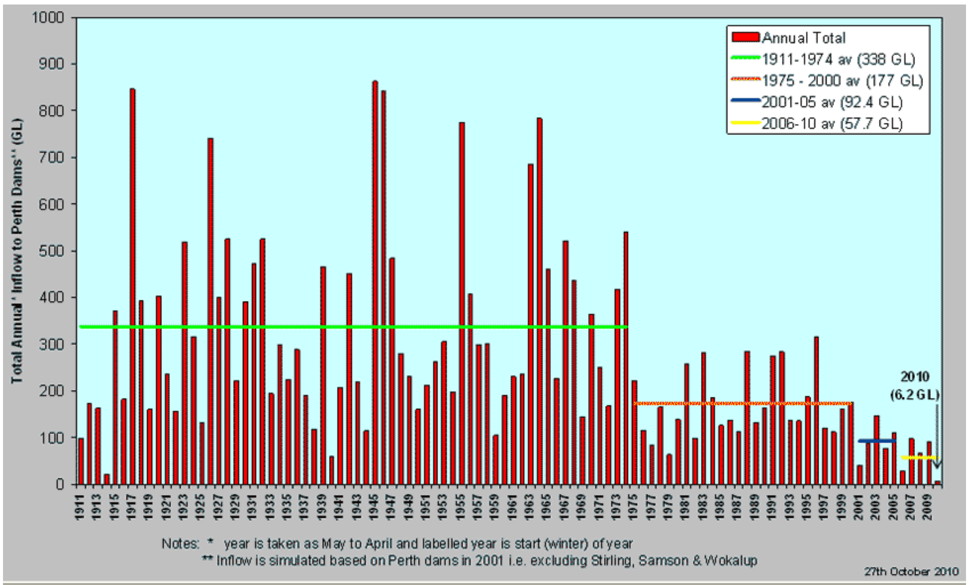
NEED TO HAVE A CATCHMENT MANAGEMENT PLAN

For both water conservation and flood mitigation, the catchment characteristics will need to have been defined – indeed under the terms on the NWI, a catchment management plan should already have been established, leading to production of Resource Operating Plans. Resource Operating Plans do not generally provide for pre-flood water releases

POSSIBLE CLIMATE CHANGE IMPACTS

Whilst it is tempting to operate from average catchment run-off figures, it is essential that the variability of rainfall is taken into account, especially where there is evidence of climate change. This is particularly graphically shown by recent figures for Perth, WA. The histograms show the natural variability of rainfall in Perth since 1911, but also show how catchment run-off has been greatly diminished over the past 35 years, reductions being noted from about 1975 onwards, with a progressive increase in severity of reductions since 2000. It has been widely assumed that this reduction represents an early expression of climate change in Australia.

[4] http://www.floodcommission.qld.gov.au/__data/assets/file/0005/5954/Sunwater_and_Burnett_Water.pdf



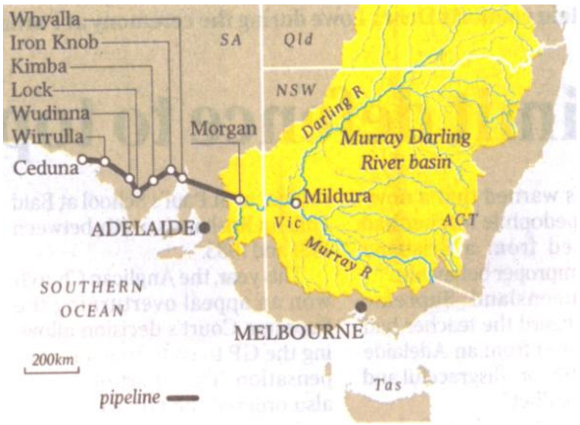
Inflows to Perth Dams from 1911 (WA Water Corporation http://www.watercorporation.com.au/D/dams_streamflow_large.cfm)

IMPACT OF LAND USE CHANGE

Irrespective of climate change issues, land use change can also have a significant impact of catchments. Forestry, whether for timber or carbon sequestration, may result in reduced flows to dams. Here again, there is a risk of conflicting policy objectives being generated (water conservation vs tree planting for carbon sequestration). In some areas where forests have not previously existed, plantation owners with new proposals are being asked to acquire water entitlements before establishing their forests.

The addition of other smaller dams by landholders in the catchment may also reduce flows to a major dam. There appear to be a variety of approaches to approvals, if required at all, to proposals for small dams in the different states. The proliferation of small dams by landholders may have a significant impact on the catchment underpinning a large dam downstream. Hence proposals for dams should be developed within an established and consistent framework of land use planning and management to ensure that the originally perceived economic, environmental and/or social purposes of a dam proposal are not overtaken by unintended consequences.

Land use may also subsequently render the water quality of that accumulated in the dam unfit for the purpose for which the dam was built. Examples include the Todd Reservoir near Port Lincoln in South Australia, becoming increasingly saline and silted so it has had to be withdrawn from the Eyre Peninsula water supply system. A link has now been provided to the distant River Murray to service Eyre Peninsula with reliable water supplies.



The Advertiser

Another example is from Western Australia - the Wellington Reservoir which was completed in 1933 to supply the Collie River irrigation district on the Swan Coastal Plain. It had an original capacity of 35 GL and a salinity of about 280 mg/L. In response to irrigation demands the dam was raised in 1946 and further work was conducted from 1955 to 1960 to provide more water for irrigation and also to supply the Great Southern Towns Water Supply Scheme (GSTWSS) with drinking water. Storage capacity was increased to 186 GL. Salinity levels in the Collie River increased steadily over from the mid-1940’s to 1992 where the average salinity stabilised at around 945 mg/L. These salinity levels have become a severe limiting factor for successful irrigation.

EXISTING RIGHTS

Proposals for dams will need to have identified any riparian rights impacted upon, and if necessary, water entitlements acquired as well as any necessary land. Issues of environmental impact, which can be of significant community as well as biological impact will need to have been addressed. Clause 78 of the NWI sets out that the outcome for integrated management of environmental water is to identify within water resource planning frameworks the *environmental and other public benefit outcomes* sought for water systems and to develop and implement management practices and institutional arrangements that will achieve those outcomes. There may be occasions where the Commonwealth’s *Environment Protection and Biodiversity Conservation Act (1999)* may be triggered. Any water flows allocated to native title holders for traditional cultural purposes will need to be accounted for.

MARKET DEMAND

Any proposals for dams will need to identify the “market” or demand for the water (or flood protection) being managed through new structures. It is implicit that potential beneficiaries understand and have assessed the risks involved in investing in a dam whose capacity may be available quite erratically due to catchment variability, and that a consumptive use policy has been determined in recognition of that variability. In that regard, the use of water trading in the Murray Darling Basin appears to have been beneficial in accommodating such variability, allowing growers of annual crops to forego planting them where returns from selling the water to perennial crop growers are more profitable.

POWER GENERATION

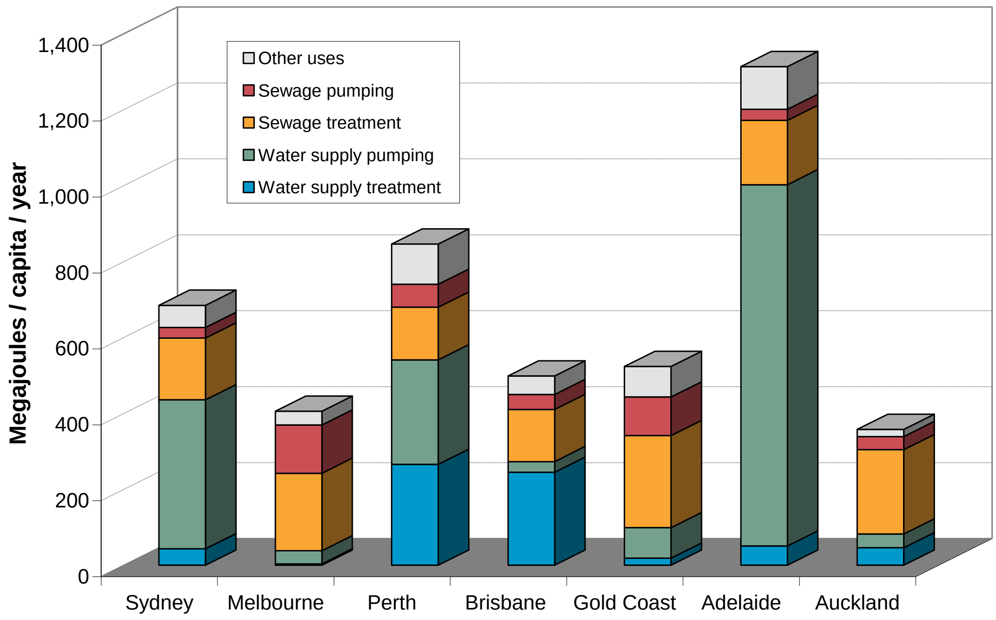
Where dams are used for both power generation and irrigation, there are likely to be conflicting demands for the availability of water. The creation of the National Electricity Market (NEM), which operates in the States of New South Wales, Victoria, Queensland, South Australia and Tasmania and in the Australian Capital Territory, serves as an incentive for power supply companies to seek the highest prices when electricity demands are high. Hydroelectricity generation is particularly well suited to capturing this market; it can be initiated almost instantaneously in response to peak electricity demands, unlike coal-fired stations which are used for base-load power and cannot quickly be brought on line, mainly due to their significant thermal inertia. However dam operations for power generation may well result in water passing from dams through generating penstocks at a time when its availability is not convenient for irrigators.

It may be noted that power generation does not “use” the water – it uses the dam’s water ‘head’ as a stored energy resource. Hydro Tasmania and the Snowy Mountains scheme both mitigate the problem of unwanted irrigation flows at times of peak generation by building holding basins or pondages below generation facilities so water can be released to irrigators only when required. However power generation facilities require water storages of low drought risk, particularly where used for high value base-load power for industry, as for example at Benmore in New Zealand.

It should also be noted that dam and storage configurations can lend themselves to ‘pumped storage’. That is, when power prices are low, water from lower storages can profitably be pumped back to upper storages for further peak alleviation using combination pump turbines. The benefits of pumped storage are significant; not only are power demand peaks and valleys intelligently handled, but also inherently intermittent renewable energy, for example wind and solar, can effectively be stored for use when needed, making such resources considerably more valuable to market operators.

PUMPING COSTS

Water is heavy. A cubic metre of water weighs one ton. Any identified dam location must take account for the transmission costs of taking the water from the dam source to the point of consumption. Pumping horizontally has an energy consumption typically over one megawatt-hour per megalitre per 100 kilometres. Added vertical lift increases energy consumption considerably. This is well demonstrated by the high pumping energy demand, and hence cost, of the Adelaide water supply system compared to other capital cities due to the need to lift water from the River Murray over the Mount Lofty Ranges.



Energy requirements of capital city water supply services (CSIRO-WSAA)

VARIABILITY OF SUPPLY

The greater the variability in the supply of the water resource to a potential dam, the more attention that must be given to potential losses prior to use. A storage that fills very infrequently will be at risk of losing much of its water by evaporation. It has been established that only about 5% of water accumulated in dams in pastoral lands of Australia is actually used productively for stock and domestic purposes – the remainder being lost by evaporation. Despite many attempts to reduce evaporation in large dams, no reliable technology has had wide acceptance. It may be possible to cover small dams used for stock and domestic purposes or critical industrial use, but there are risks of damage from native or feral animals. Losses are also high in open channels, particularly if unlined, which is why all the irrigation areas in South Australia are now pipelined, and the current Northern Victoria Irrigation Renewal Project (NVIRP) is lining many earth channels with plastic – a technology which it is asserted will be effective for 30 years. However, this may reduce recruitment of surface water to groundwater, potentially reducing the available groundwater resource.

Where new irrigation areas are planned, it needs to be established whether irrigation is legally possible. On some leasehold lands in what are currently pastoral areas, introduction of non-native species is prohibited, thereby precluding the irrigation of introduced agricultural crops and pastures.

ECONOMICS

The States, in signing the Intergovernmental Agreement on the National Water Initiative, agreed (clause 65) to the following:

> *In accordance with NCP commitments, the States and Territories agree to bring into effect pricing policies for water storage and delivery in rural and*

urban systems that facilitate efficient water use and trade in water entitlements, including through the use of:

i) consumption based pricing;

ii) full cost recovery for water services to ensure business viability and avoid monopoly rents, including recovery of environmental externalities, where feasible and practical; and

iii) consistency in pricing policies across sectors and jurisdictions where entitlements are able to be traded.

Specific commitments are included for metropolitan systems at Clause 66. The following was agreed with regard to Rural and Regional Systems:

> *Full cost recovery for all rural surface and groundwater based systems, recognising that there will be some small community services that will never be economically viable but need to be maintained to meet social and public health obligations:*
>
> *a) achievement of lower bound pricing for all rural systems in line with existing NCP commitments;*
>
> *b) continued movement towards upper bound pricing for all rural systems, where practicable; and*
>
> *c) where full cost recovery is unlikely to be achieved in the long term and a Community Service Obligation (CSO) is deemed necessary, the size of the subsidy is to be reported publicly and, where practicable, jurisdictions to consider alternative management arrangements aimed at removing the need for an ongoing CSO.*

Whilst the Intergovernmental Agreement on a National Water Initiative is not a statutory instrument, its principles have recently been reinforced by reports from the Productivity Commission "Australian's Urban Water Sector – Draft report April 2011"[5].

However, the current government has established the $5.8 billion Sustainable Rural Water Use and Infrastructure (SRWUI) program. The program's objectives are to increase water use efficiency in rural Australia, and investment will be principally directed to projects that:

• deliver substantial and lasting returns of water for the environment
• secure a long-term future for irrigation communities
• deliver value for money in the context of the first two tests.

In addition to upgrades funded through government programs, there is a strong incentive for irrigators and infrastructure operators to invest in cost-effective infrastructure projects themselves. This is because of the potential for cost savings, productivity improvements and water savings that stem from upgrades to irrigation infrastructure, though there is evidence that infrastructure upgrades are an expensive form of water conservation. Modern infrastructure principles need to be considered in the design of any new projects for which dams will be developed.

It may be noted that the National Water Commission in its recent report "*Review of pricing reform in the Australian water sector"* commented that future directions,

[5] http://www.pc.gov.au/__data/assets/pdf_file/0006/107745/urban-water-draft.pdf

prolonged drought and water scarcity “also saw governments intervene in water planning and investment decisions. Such interventions, while well intentioned, can confuse accountability arrangements and blur industry incentives to invest optimally. Government subsidisation of urban and rural water infrastructure investments has constituted a step backwards from the commitment to price water according to the true cost of the resource, capital assets and service delivery.” Governments must face evaluating the benefits and equitability of subsidies from taxpayers to support economic development of new industries potentially benefiting only a small number of producers.

Therefore the Academy considers that a Benefit:Cost Analyses should be undertaken for any new dam and associated infrastructure proposal, irrespective how it is ultimately financed, and that any projects must be shown to be economically, environmentally and socially viable before any commitment to proceed is made.

FOOD SECURITY

With regard to the issue of food security, the Academy does not believe that Australia faces any immediate problem of food security. Australia’s lifestyle can be enhanced by the import of out-of-season produce from overseas where appropriate import risk assessments have been satisfied and where long term storage of local produce may be difficult. However, with a potential population of 9 billion people within a few years, the world does face a problem of food security. This raises considerable opportunity for Australia’s rural industries to increase productivity to meet a likely export demand for high quality produce.