Submission No 25

INQUIRY INTO ADEQUACY OF WATER STORAGES IN NSW

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The Hon Rick Colless MLC
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Standing Committee on State Development
Inquiry into the Adequacy of Water Storages in NSW

Legislative Council
Parliament of NSW
Parliament House
Macquarie Street
Sydney, NSW, 2000

Dear Mr Colless,

SUBMISSION: INQUIRY INTO THE ADEQUACY OF WATER STORAGES IN NSW

Thank you for your invitation to provide a submission to this very important and timely inquiry.

This submission addresses the Terms of Reference of the Inquiry, specifically:

e) water storages and management practices in other Australian and international jurisdictions.

f) any other matter relating to the adequacy of water storages in NSW.

The focus of this submission is the need to consider the role of 'flood mitigation' that many reservoirs do (or could) play, in conjunction with any consideration of their role as water supply storages.

1. MY BACKGROUND AND EXPERIENCE

I am a Senior Lecturer in the School of Civil & Environmental Engineering, where I undertake research and teaching activities in the fields of water chemistry, drinking water and wastewater treatment, risk assessment and sustainability. I also lead the research stream on trace organic chemicals in water at the UNSW Water Research Centre. I am a current member of the Water Quality Advisory Committee to the National Health and Medical Research Council (NHMRC). On that committee, I provide expert advice on many issues associated with water quality and health. I am a member of Engineers Australia (MIEAust).

2. DUAL ROLE FOR MANY WATER SUPPLY RESERVOIRS

Many water supply reservoirs are required to serve two somewhat contradictory roles. These are:

A. Maintain adequate water storage to buffer seasonal and longer-term variability in natural water availability.
B. Mitigate the effect of flooding on downstream communities during circumstances of extremely high run-off and river flow.

These two roles can apply to both on-stream and off-stream storages. The first role (A) generally requires that the management of a reservoir would be optimised to store as much water as physically possible. However, the second role (B) requires that the reservoir be managed so as to maintain a significant volume of '*available*' storage capacity for flood mitigation. Accordingly, some competition between these two roles is inevitable and the management objective should be to identify the optimum balance between the two objectives. The adequacy of existing water storages should not be assessed without concurrent consideration of the adequacy of existing reservoirs for flood mitigation.

3. EXAMPLE OF LAKE WIVENHOE (SOUTH EAST QUEENSLAND)

Lake Wivenhoe is the principle water storage reservoir for South East Queensland, including Brisbane. The full 'holding capacity for Lake Wivenhoe is approximately 2615 gigalitres (GL). However, this capacity is conceptually divided into two components. The lower 1165 GL is managed as the water supply capacity, while the upper 1450 GL is maintained for flood mitigation. When inflows to the reservoir cause the full supply level to be exceeded, water is released in order to maintain levels as no greater than 100% of the full supply capacity. The water storage levels in Lake Wivenhoe during 2000-2011 are illustrated in Figure 1 (SEQWater, 2012). The vertical axis in this figure is the (accessible) volume of water contained in Lake Wivenhoe. The percentage figures relate to this volume as a percentage of the official full supply capacity.

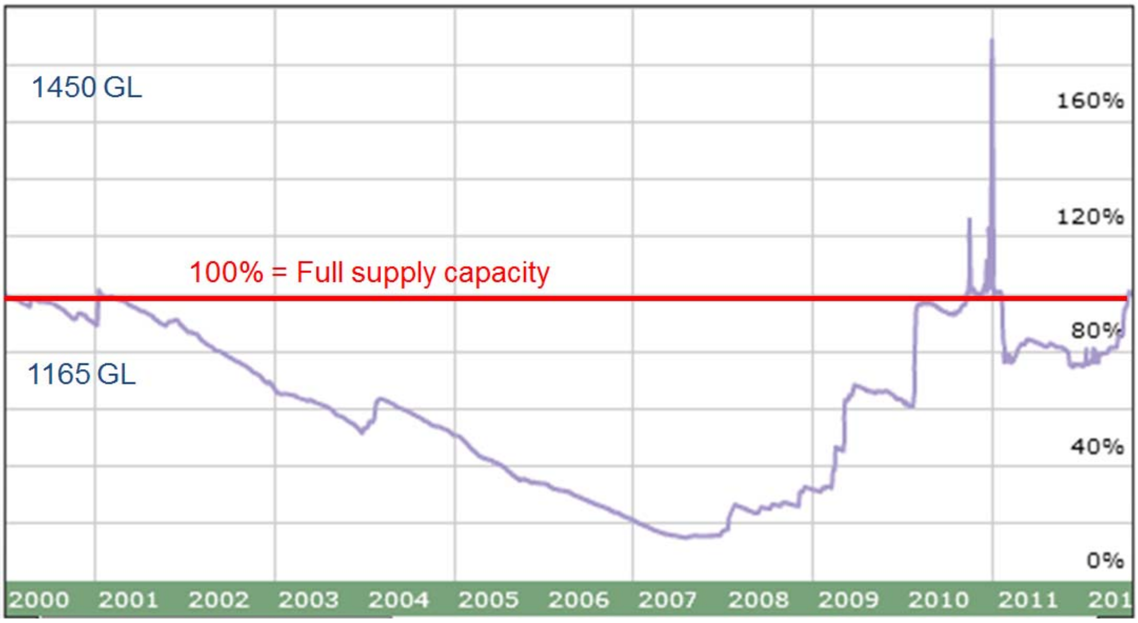

Figure 1 Water storage levels in Lake Wivenhoe 2000-2012 (SEQWater, 2012).

Figure 1 reveals the effectiveness of Lake Wivenhoe in buffering water storages against the severe drought during 2001-2009, as well as mitigating the impacts of the flooding event in January 2011. Had the flood mitigation capacity been compromised by pressures to increase the full supply capacity, the 2011 floods in Brisbane would have been even more devastating than they were.

4. EXAMPLE OF LAKE BURROGORANG (WARRAGAMBA DAM)

Not all water supply reservoirs are operated with a flood mitigation capacity. Despite being one of the largest water storages in the world, Lake Burrogorang (Warragamba Dam) is one such example. The full operating storage of Lake Burrogorang is 2027 GL. At the time of writing, the storage level was at 99.9% of capacity. The total water storage for Sydney during 1998-2012 is presented in Figure 2 (Sydney Catchment Authority, 2012). Lake Burrogorang contributes approximately 80% of this total storage and the general trend for the storage levels in the lake are approximately represented by Figure 2.

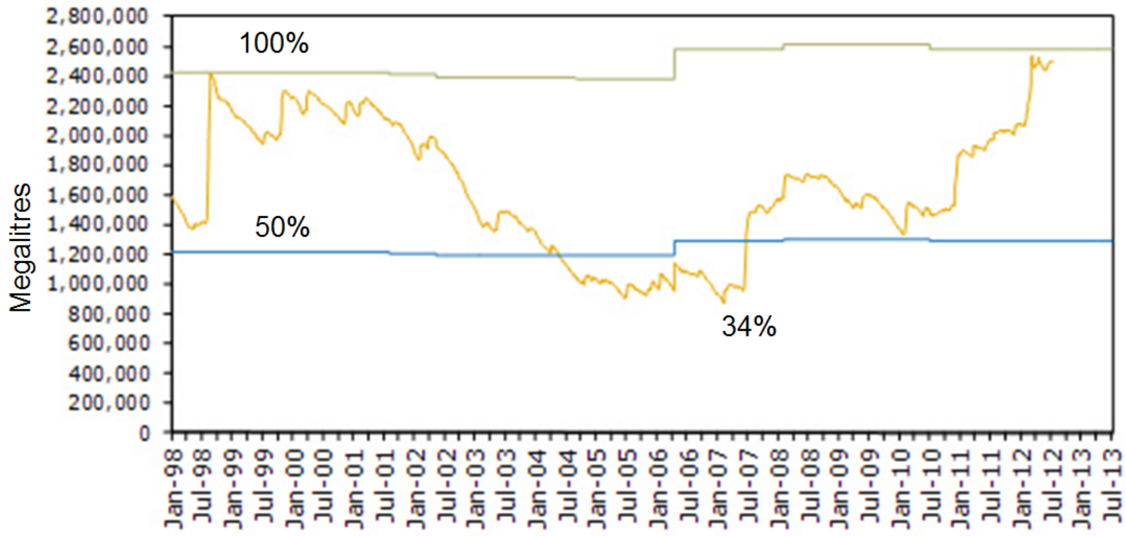

Figure 2 Water storage levels in Sydney during 1998-2012 (Sydney Catchment Authority, 2012)

Lake Burrogorang has been subject to some very large and sudden inflows, such as that which caused the very sharp increase in storage in July 1998 (see Figure 2). In the lead-up to that event, storage levels were relatively low and sufficient additional capacity was available to prevent a very large flood from occurring in Western Sydney (though major flooding occurred in Wollongong, which was much less protected). Water that is released from (or breaches) Warragamba Dam flows a short distance down the Warragamba River before joining the Hawkesbury-Nepean River. The largest Hawkesbury-Nepean flood on record occurred in June 1867, in which flood waters reached approximately 12 metres higher than the deck of the present-day Windsor Bridge (NSW State Emergency Service, 2012).The NSW State Emergency Service maintains maps of areas that were inundated by the 1867 flood (NSW State Emergency Service, 2012). The impact of the 1867 flood and of a "probable maximum flood" have been described by Gillespie *et al.* (2002):

> *"[In 1867], floodwaters reached 19.2m Australian Height Datum (AHD) in Windsor—three metres higher than the majority of development there today and two metres higher than the current flood planning level of 17.3m AHD . The probable maximum flood (PMF) will reach to 28.9m AHD or 11 metres above the planning level in Windsor (Figure provided). Even with the new Warragamba Dam spillway, a PMF will reach 26.4m AHD. Detailed estimates provided by Sydney Water shows that the PMF could cover an area of 300 km^2 —completely inundating Richmond, Windsor, McGraths Hill and partially flooding Penrith, Emu Plains and Riverstone. Such a flood or smaller ones would cause untold devastation and potentially significant loss of life".*

If the inflow event of July 1998 was repeated today (July 2012), there would be no capacity to hold back any additional water. The approximately 1000 GL of water that were captured in 1998 would instead overflow down the Warragamba spillway in 2012. This is almost twice the volume of water contained in Sydney Harbour (560 GL).

5. OPPORTUNIITIES FROM ALTERNATIVE WATER SOURCES

Alternative sources of municipal water supply including seawater desalination and direct potable reuse of highly treated municipal effluents provide an opportunity to maintain or even increase the flood mitigation capacity of some reservoirs without jeopardising water supply security. The potential or continual availability of water from these sources represents an increased 'virtual' storage capacity.

5.1 Example of the Western Corridor Water Recycling Project (WCWRP)

I have previously described how the Western Corridor Water Recycling Project (WCRWP) in South East Queensland could be used in this way to enhance the flood mitigation capacity of Lake Wivenhoe (Khan, 2011).

When operating at full capacity, the WCRWP can produce up to 230 ML/day of potable-quality recycled water. The average total water consumption across all of South East Queensland is roughly 630 ML/day (Queensland Water Commission, 2010). Full supply capacity of Lake Wivenhoe is 1165 GL (Figure 1), which is approximately 1840 times the average daily consumption volume. If 230 ML/day were supplied by direct potable reuse of water produced by the WCRWP, the remaining average daily water demand would be (630-230=) 400 ML/day. In order to maintain maximum storage of 1840 times the average daily consumption volume, only (400 x1840=) 740 GL would be required. The remaining 425 GL of storage volume could then be preserved for flood mitigation. The current volume reserved for flood mitigation in Lake Wivenhoe is 1450 GL. Accordingly; direct potable reuse from the WCRWP would enable this to be increased by around 30%.

To put this extra storage capacity into some context, a new 425 GL reservoir would be the fourth largest reservoir to supply drinking water to a major city in Australia (after Warragamba in Sydney, Wivenhoe in Brisbane and Thompson in Melbourne). It would be more than 70% of the total storage capacity of Water Corporation in Perth and twice the total storage capacity of Adelaide.

This new ‘virtual reservoir;’ would have numerous benefits over the construction of an actual new dam. These include the fact that the water would be available immediately, there would be negligible construction costs (using the existing WCRWP), there would be no need to relocate a single home or farm, none of the environmental impacts of new dams and reduced capture of water would enhances natural river flow regimes.

The possibility of raising Wivenhoe dam by 4 meters, in order to achieve an additional 481 GL of storage volume was recently considered (SEQWater, 2007). This option was estimated to cost $138 million. Additional impacts were also identified including the need to temporarily relocate the Brisbane Valley Highway with major disruption to traffic. Significant reductions in land available to lease holders, loss of environmentally sensitive habitat (significant), and loss of public and private recreation areas were also forecast.

5.2 Example of the Sydney Desalination Plant

A similar analysis could be undertaken for the Sydney Desalination plant. The Sydney desalination plant can currently supply around 250 ML/day of potable water to Sydney. The plant has been designed to be expandable to a size sufficient to supply 500 ML/day if needed.

Current annual water demand for Sydney is on the order of 600 GL/year (1.7 GL/day). Full storage capacity of Sydney is 2582 GL, which is approximately 1630 times the average daily consumption volume. If 500 ML/day were supplied by seawater desalination, the remaining average daily water demand would be (1700-500=) 1200 ML/day. In order to maintain maximum storage of 1630 times the average daily consumption volume, only (1200 x 1630=) 1956 GL would be required. The remaining 626 GL of storage volume could then be preserved for flood mitigation. To put this figure in context, this is larger than the commonly quoted volume of Sydney Harbour (560 GL). It implies the ability to mitigate against extremely large inflows.

Given this analysis, the knowledge that the Sydney desalination plant is available and could be relatively quickly brought online (and expanded to full capacity) should enable Lake Burrogorang storage levels to be lowered by more than 600 GL with a high level of confidence that Sydney's water supply security will be maintained. The major advantage of such a change would be the significantly reduced risk of a major flooding event in western Sydney.

It may be argued that the Sydney desalination plant is already accounted for in determining Sydney's overall water security. However, the historical trend in Sydney's water storage volumes and the fact that the desalination plant is currently not operating, indicate that this is currently a redundant component. I note that a number of experts and commentators (including myself) provided such advice to the NSW Government prior to construction of the plant (General Purpose Standing Committee No 5, 2006).

5.3. Opportunities to enhance flood mitigation capacity of NSW reservoirs.

The two examples given above are provided only to illustrate the type of thinking and the major

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benefits that can be produced by the identification and incorporation of non-traditional water sources. No general analysis of opportunities to enhance the flood mitigation capacity of NSW reservoirs by the incorporation of alternative water sources has been undertaken. However, such an analysis should be undertaken as a component of any review of storage volumes in NSW.

6. RECOMMENDATIONS FOR THE INQUIRY COMMITTEE

The following recommendations are provided for consideration by the Committee:

- Any analysis of the adequacy of water storages in NSW should be undertaken with a concurrent analysis of flood mitigation capacity
- Any change in reservoir management undertaken to increase the 'full supply level' should be assessed in terms of current or potential impacts to the flood mitigation capacity of the reservoir.
- All reservoirs which are not currently managed with a flood mitigation capacity should be reviewed in terms of the potential need and opportunities to implement a flood mitigation capacity.
- Opportunities to 'free up' flood mitigation capacity by the use of alternative water supplies such as seawater desalination and direct potable reuse should be assessed.

I hope that you will find my submission to this inquiry to be of value and interest to the Committee. Furthermore, I would be very happy to provide any required clarification or additional information that may be requested. I wish the committee well in the important task ahead of them and look forward to reading the outcomes of this inquiry.

Yours sincerely,

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