Submission on The Environmental Impact Statement for the Warragamba Dam Raising Project

Introduction

This submission to the Warragamba Dam Raising Project (WDR) EIS is because over the last year I have been a participant in the World Federation of Scientists meetings of the Permanent Monitoring Panel - Mitigation of Catastrophic Risk. The objectives of this organisations are to understand how risks to the planet are evolving and how science can be used to both understand them and assist in responses to the risks the threats pose.

I am part of a small group of independent scientists in Australia who have been developing new simulations tools to allow assessment of complex problems within society. The vision has always been to provide a simple means to overlay threats to population groups and provide information to mitigate the threat. Over the last year we have developed a simulator for the population of Sydney and have overlain it with Covid-19 infection. The focus has been to develop a scientific basis for the development of the disease within an individual and how it is then spread to the community rather than use the standard epidemiological modelling methods which are based on a number of assumptions that are scientifically questionable. In the past we have provided advice to NSW SES on tsunami and transport emergency plans that include modelling of human behaviours and to the Federal Government on terrorism behaviour modelling.

This is an individual submission and is made in the light of some 40 years' experience in analysing catastrophic risks that affect society, from some of the most serious mining and chemical accidents in this country and internationally and also to chemical and transport risks across this country.

Yours Sincerely 

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Summary of Conclusions and Recommendations

1. The raising of the dam wall does not build resilience for Sydney, NSW or Australia, but increases the vulnerability of the dam to both natural and behavioural catastrophic risk. These risks were not canvassed or discussed in the EIS in breach of the SEAR's Guidelines for a sustainable future. The consequences of dam failure (including deliberate destruction) are so extraordinarily severe that these risks must be properly addressed by the EIS and associated studies.
2. The trend in water engineering internationally is to replace dams with alternative water and energy resources and to seek non-environmentally intrusive solutions.
3. It has been concluded in this Report that the assessment of the impact of raising the dam wall on the World Heritage Area, Aboriginal Heritage and Culture is invalid because it is not aligned to the environmentally sustainable development of resilience for Blue Mountains and Hawkesbury-Nepean Valley communities.
4. It is recommended that new options be considered that do increase resilience for Sydney, NSW. This includes developing desalination technology powered by renewable energy. which has advanced significantly since the first desalination plant was built in Sydney. The dam water level could be reduced progressively as each plant comes online, reducing the existing flooding risks and preventing the additional risks associated with raising the dam.
5. It is recommended that there be a lowering the dam water level by some 30m to increase environmental sustainability and to reduce the population risk downstream. This will also ensure that to ensure that Gundungurra land is not impacted in the future and is protected for future generations.
6. It is recommended that Ministers and Heads of Government Departments seek analysis of a range of options which will demonstrate wide consultation and data assessment and, on this basis, make a reasonable judgement that will be upheld for the life cycle of the dam.
7. It is recommended that the SES with water engineering and catastrophic risk consultants develop and test plans for failure of this dam and apply findings to all other major dams in NSW. This plan testing is an essential process in reducing the catastrophic risk to the population of Western Sydney from collapse of the Warragamba dam. The benefits to the population and the environment will be a significant lowering of catastrophic failure risks and an advancement in procedures for sustainability of the environment.
8. It is recommended that the NSW Government Treasury should include calculations, risk assessments and the externality risks and identify funding responsibilities for ongoing projects and have oversight on the procurement before contracts. This action will minimise unquantified proposals and create an audit trail.

9. It is recommended that funding be provided for a multidisciplinary water engineering, risk, archaeological and anthropological study of the 300 or so sites identified in partnership with the local Gundungurra community.
10. It is Recommended that the Blue Mountains World Heritage area be universally protected from development including the land surrounding this area and that the area adjoining the World Heritage Areas be assessed to extend the World Heritage Area.
11. It is a conclusion of this Report that the drought-flood cycle can be used as a means for providing sustainable futures to the Western Sydney and Western Plain Communities and in particular sustainable water resources. This can be incorporated into ongoing analysis of options.
12. It is recommended that funding be provided for a multidisciplinary water engineering and scientific study of building offshore desalination plants to take advantage of wind, wave and ocean current energy. This option can be used to purify seawater and provide the energy to pump the water to supply the Western Plains.
13. It is recommended that an engineering report be sought on the safety and life expectancy of the dam and to consider strengthening the dam and upstream and downstream infrastructure if recommended.

Submission

The WDR Environmental Impact Statement is obliged to present an accurate and true assessment of the risks and opportunities in this project. The EIS and its associated appendices does not deliver this requirement. Over 4000 pages of documents, much of which does not meet technical requirements, had to be assessed by the general public in 45 days (with a later extension of 17 days). This time does not allow full independent technical evaluation from community organisations.

Comments in the press by Mr Stuart Aires, Minister for Jobs, Investment, Tourism and Western Sydney and the Minister for Trade and Industry state that the EIS provides “a full understanding of what is proposed.” Not only is this statement unsupported but much of the technical information behind the project is unavailable to the public. As a result, the public is unable to form an objective view of the benefits of this project. There is an overstatement of the net benefit to the community and underreporting of the risks and a serious distortion of the public’s perception of a sustainable solution for the future. There is a past history of failure of transparency in public private partnerships and Treasury oversight is required for this critical infrastructure project.

The current proposal increases the risk to the public purse and allows development in areas that should be protected. A feature of what is being proposed, which will be discussed more fully below, is mission creep to further extend water retention at Warragamba. Minister Ayres, who is the State Member for Penrith, would through this project be supporting the future loss of residences, potential loss of life and damage to the environment affecting many within his own electorate. For this reason it is a primary recommendation of this report that other options be added to the Government's planning for the dam.

SEARS Requirements are not met by the Dam Proposal

The revised version of the Secretary's Environmental Assessment Requirements (SEARS) for the EIS required:

- The project is described in sufficient detail to enable a clear understanding that the project has been developed through an iterative process of impact identification and assessment and project refinement **to avoid, minimise or offset impacts so that the project, on balance, has the least adverse environmental, social and economic impact, including its cumulative impacts.**
- Impacts are **assessed objectively and thoroughly to provide confidence** that the project will be constructed and operated within acceptable levels of impact.
- The project design considers **all feasible measures to avoid and minimise impacts on terrestrial and aquatic biodiversity**. Offsets and/or supplementary measures are assured which are equivalent to any remaining impacts of project construction and operation.
- The project is designed, constructed and operated to be **resilient to the future impacts of climate change**.
- The project minimises adverse impacts on existing flooding characteristics. Construction and operation of the project avoids or minimises the risk of, and adverse impacts from, **infrastructure flooding, flooding hazards, or dam failure**.
- The project avoids or minimises any adverse health impacts arising from the project**.** The project **avoids, to the greatest extent possible, risk to public safety**.
- The design, construction and operation of the project facilitates, to the greatest extent possible, **the long term protection, conservation and management of the heritage** significance of items of environmental heritage and Aboriginal objects and places.
- The design, construction and operation of the project **avoids** or minimises impacts, to the greatest extent possible, on the heritage significance of environmental heritage and Aboriginal objects and places.

- The project **minimises adverse social and economic impacts and capitalises on opportunities** potentially available to affected communities.
- Sustainability - The project reduces the NSW Government's operating costs and ensures the effective and efficient use of resources. Conservation of natural resources is maximised.

The bold highlights above indicate that the project is to assess risks and their control to avoid impact as much as possible. This submission will discuss how the risks have been underestimated in the EIS by the Government and demonstrate that there are options which will be more environmentally acceptable that do not incur many of the potential losses.

An independent assessment of the catastrophic risks to this project is provided in an appendix to this submission.

It is clear from the discussions in the EIS documents and appendices that studies of the many catastrophic risks that affect the dam and society from this project were not identified and reported for public scrutiny. The appendix attempts to redress this situation. There is no supporting evidence that the proposed dam project can achieve the objectives that are set by the Government for a sustainable future for the people of NSW.

There has not been an assessment of processes leading to dam collapse and the range of impacts. This key requirement by SEARS has not been met.

There is no evidence of modelling for failure, what code was used and what scenarios and boundary conditions were used for these scenarios. Without this information, the general public cannot judge whether the dam is actually stable enough to act in the way described.

It is to be noted that there are currently many rumours circulating in the Hawkesbury-Nepean valley and Blue Mountains that the dam is not safe but there is also no engineering information to clarify to the public on the safety or failure risks of the dam and future risks of collapse.

There was supposedly a report on dam break that was published on 31st March 2021 but searches within Data.NSW suggested it was published on the NSWSES website. This site only showed a data removed error and no access to a report. The Dambreak study on another dam in NSW is also no longer available on the site.

Local politicians have been unable to access this information under FOI. A search of the EIS documents for the terms, “dambreak”, “collapse”, “break”, “failure”, “burst”, “terror”, “explo…”, yield very few results that were in the context of a dam collapse (See Table 1).

The conclusion to these searches is that the catastrophic risks inherent in this proposal have either not been addressed (as there is no data within the EIS of how dam break or failure of collapse is to be avoided) or of what controls have been built into the process.

The one citation of “dam break” in the EIS was of *dam break manning factors* on a graph which are needed to compute flows across a terrain. This may indicate some study has been undertaken and there can be no claim that “dam break” had been discussed when it has not. The nature of this study is not mentioned in the EIS.
Under SEAR’s requirements it is not acceptable that studies of dam failure are omitted and Sears specifically states that dam break and collapse should be part of the studies. It is an important aspect of transparency for Government to report all such studies.

Search term	Number of hits, volume reference	Context
dambreak	1, p33/113 appendix H2	Map edge title: Mannings Values – these only indicate the average friction factors used for modelling in TUFLOW which is only used in Figure 3 and does not relate to dambreak inundation. Table 1 lists the Manning's values and their described application in the model.
Break	1, p33/113 appendix H2	One reference to dam***brea***k (above). A few references to ***break***out of flooding across roads. A few references ***break***down used in the context of shareholders in the Social economic assessment and trucks in traffic and transport.
Collapse	0	None to collapse of the dam. A few to riverbank cliff collapse, tourism collapse, indigenous site collapse and impact of bushfires causing structural collapse of ecosystems.
Failure	9, Appendix A SEARs.pdf, Appendix H1 Flooding and Hydrology, EIS Appendix M Socioeconomic Impact Assessment, Appendix N2 Geomorphology Technical Assessment, Chapter 04	Two of the references were in SEAR's requirements for assessment in flood and hydrology. The flood and hydrology appendix references one instance purportedly showing what was being covered in this appendix. There were 4 references to dam failure in Appendix M. All the references were about how dam failure was prevented in the 1996-2006 upgrade to the dam, not about how this requirement is satisfied. The were no references to dam failure in Appendix N, although there were 19 failures in other contexts – mainly river and cliff bank failure. There were two references to dam failure in Chapter 4. One was about the project in 2004 to raise the dam wall and the second were performance requirements to minimise impact.
Burst	0	None related to collapse of the dam. One in the context of pre***burst*** rainfall in relation to rain variability on flood levels

Terror	0	No references to Terror or Terrorism.
Explo…	0	No reference to **explo**sions in relation to dam failure but several in respect of blasting operations and vulnerability of the e**xplo**sions store while raising the dam wall. Several references to **explo**iting and **explo**red

Table 1 Search terms in the EIS

Complexities and Conflict within DPIE

The NSW Department of Planning, Industry and Environment can be conflicted by competing pressures if the proposed dam project is continued. Part of the remit of DPIE is to ensure a sustainable future by ensuring there is a strong resilience in the community, a resilient and sustainable environment as well as resilient and secure water resources.

For most infrastructure projects, DPIE requires investment by industry and commerce to enable infrastructure to be built. The process is often started outside the organisation with political lobbying of investment proposals from industry and others regarding what they require. To be accepted there must be a business plan and a risk assessment that demonstrates that the proposal leads to a sustainable outcome.

It is therefore recommended that Treasury documentation should include calculations, risk assessments and the externality risks associated with such projects and provide an oversight function and audit. This will safeguard the processes of who should pay with ongoing projects and contract procurement. It is essential to bring in this level of oversight to remove lobby industry proposals and any other proposals where there is not a professional engineering and other inputs that can be technically assessed and quantified.

A problem arises in this critical infrastructure project when the risks focus is on expected and unexpected outcomes as it ignores credible catastrophic risks. Figure 1 shows both the likelihood-consequence curve and the risk exposure curves. 80% -90% of outcomes can be mitigated easily and this reinforces belief politically and in industry that a Pareto law (that for many outcomes, roughly 80% of consequences come from 20% of causes) will suffice for infrastructure. While this Perito law approach is commonly used by business to provide alternative pathways for business to grow, it does not work for infrastructure projects such as dams. Business will usually adapt their approach if the circumstances change to avoid going into liquidation. Static

infrastructure cannot adapt quickly. As a consequence, there is political pressure from investors and industry to play down catastrophic risks in favour of the more immediate business outcomes. Cost-benefit analysis ignore these catastrophic risks in their analysis.

The risk exposure curve in Figure 1 tends to decline in line with decreasing likelihood of an event occurring until risk controls are not strong enough to mitigate the risks. These are usually for catastrophic events and the risk exposure sharply increases

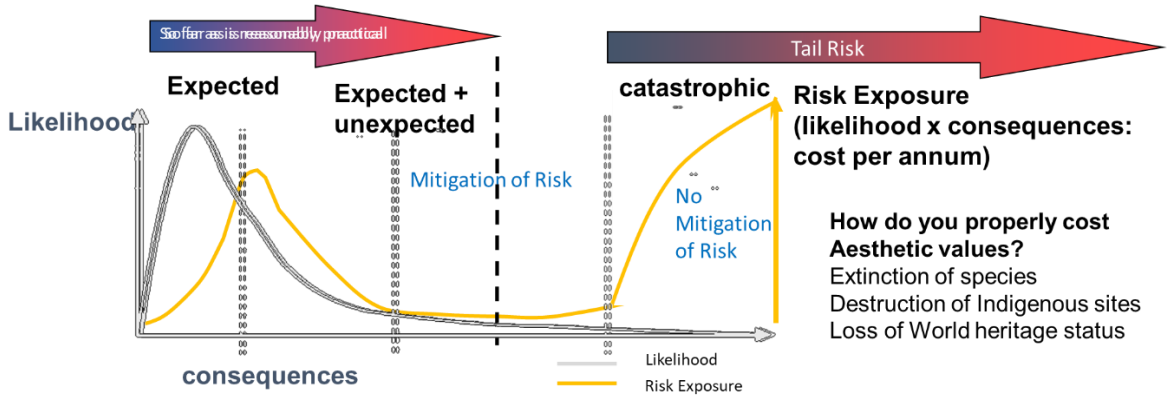

Figure 1 Assessment of Risk

when these events are considered. There is a further complication on how aesthetic values are not appropriately evaluated. The NSW Government tends to use a unitarian approach where the risk is costed from proxies such as tourism impacts or the use of offsets. This approach does not address the hazards of the project proposed for the dam.

Safety of infrastructure has always been at odds with the wants of industry and commerce. The Black Swan failures are seen as commercially intolerable but in dam engineering the life cycle of a dam requires these to be included.

The Flood Drought Cycle

Unfortunately, the EIS for the dam raising project only assesses the flood risk and fails to assess the combined flood-drought cycle risk. A consequence of this is the DPIE is focusing on a solution that is far from optimal and in the longer term will be a burden on the public purse. The EIS effectively locks the Government into a cycle of increasing the dam strength and size because of changes to the external threats that can cause collapse of the dam. The recurring cycle shown in Figure 2 as blue boxes, impacts on all the boxes in brown. The magnitude of the impacts is dependent on the ultimate strength of the dam against these catastrophic threats. They are both natural and behavioural threats which vary with time.

The process is cyclical as shown in Figure 2. The Dam Safety Regulator requires Water NSW to demonstrate the safety of Warragamba Dam every 15 years. This includes assessing the changes in risk to the dam that have occurred and because of the catastrophic nature of dam collapse requires quantitative modelling of credible threats to the dam based on good engineering principles. This approach does not stop major failures in a system. It is the absence of an assessment and control of human factors in government that lead to such failings. Having a Department that combines industry, investment with planning and environment leads to continual conflicts of interest and increases the potential for corruption of ministers and heads of sections

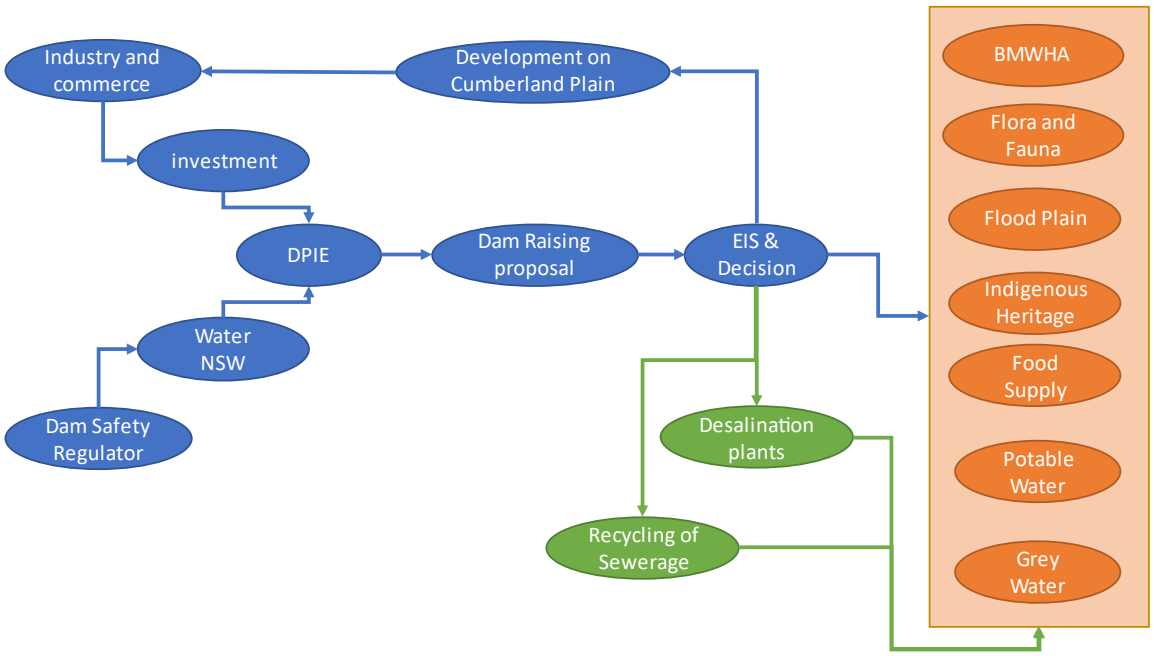

Figure 2 Requirements for assessing the safety of Warragamba Dam.[1]

by industry to achieve their outcomes rather than a sustainable future which is the stated goal of the Department. Figure 2 indicates that there is a natural feedback loop every 10 to 15 years to change the function of the dam either by raising the wall or enclosing the wall to make a temporary upstream zone a permanent one or by increasing the upstream impact zone. It is neither sustainable or an appropriate use of land.

Sydney has four international vulnerabilities to International Terrorism: the Opera House (iconic Target), The Harbour Bridge (a lifeline of the city for transport), the Nuclear medicine Facility at Lucas Heights (a lifeline for medical treatment) and Warragamba Dam (a lifeline of the city for water). The harbour bridge is now less of a

[1] This diagram was developed for the assessment of catastrophic risk in the attached Appendix.

vulnerable target because of the building of alternative transport routes (City Metro and two Harbour Tunnels). Warragamba dam is still a point vulnerability to cyber and physical attack.

A drought leads to shortages of water not only in Sydney but in the food bowl of NSW on the Western Plains. The desalination plant built that was built in Sydney can supply the current daily requirements of Sydney including environmental flows from the dam. This suggests an alternative strategy if the requirement of the full drought flood cycle is properly costed. The green boxes in Figure 2 show alternatives to raising the dam wall to ensure that water security occurs through these cycles. Increasing the number of desalination plants and placing them offshore provides a distributed water system that reduces the reliance and vulnerability to terrorism of Warragamba Dam.

Catastrophic Risks

Figure 3 is reproduced from the Appendix and indicates credible mechanisms by which catastrophic flooding and collapse of the dam can occur. Loss of the dam wall results in inundation downstream of the dam which behaves differently from a flood because of its speed and height. It causes much worse damage and loss of life than a flood. There is very little time to evacuate people and the roads become clogged and are liable to be washed away due to the height and speed of the water into areas not normally flooded. The estimated cost if the dam wall was destroyed is about $4-$5 trillion due to the loss of life, loss of property, loss of business because of loss of water supply for up to 7 years within Sydney. The lifetime of the infrastructure is meant to be 100 years. If the dam was lost just once in this time period then the risk exposure is $40-50 billion per annum. This means that spending this amount per year on alternative outcomes is a preferred cheaper cost on society than allowing the dam to be destroyed.

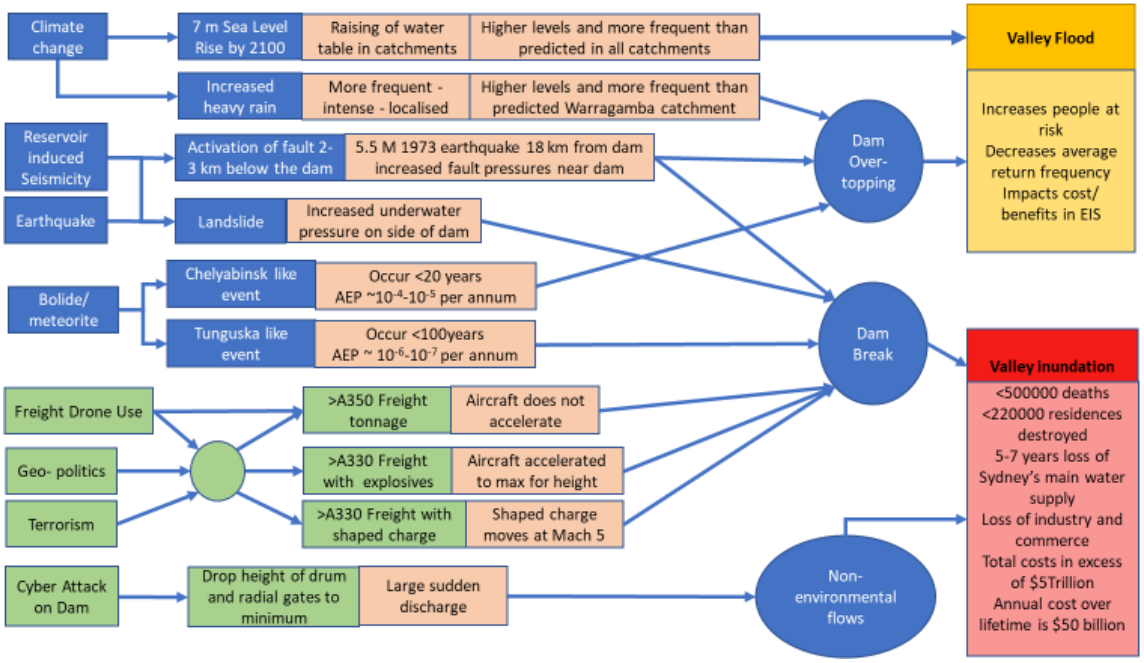

Figure 3 Credible Catastrophic risks affecting Warragamba Dam.[2]

The trend, internationally, is to move away from dam construction and replace the water supply and energy production that might be lost with alternative supplies.

An obvious candidate is the use of desalination plants to provide an alternative water supply. The costs of these plants have come down significantly since the building of the plant in Sydney. There has also been a move to commercialise wind, wave and extracting energy from ocean currents with costs continuing to decline.

Rather than raising the dam wall, siting of some 10 desalination plants off the NSW east coast has a number of advantages:

1. They can supply water for both Sydney and the West of the State in times of moderate and severe drought.
2. It presents a unique opportunity for a distributed strong infrastructure design that will resist cyber or physical terrorism, natural hazards and accidents.
3. It provides a reliable potable water supply to townships west of the Great Dividing Range by supply of reliable potable water during the worst ravages of drought.
4. It provides an alternative water supply for crop and animal husbandry to farms west of the Great Dividing Range during periods of drought.
5. It allows riverine systems to be returned to their natural state of flow.
6. It provides a sustainable outcome for the population of NSW

[2] This diagram was developed as part of the catastrophic risk study in the appendix.gh

7. It reduces the vulnerability of Warragamba Dam as a target for International Terrorists
8. The level in Warragamba Dam can be reduced to about 30m allowing the current dam to provide an additional buffer against PMF floods.
9. The cost of providing 10 desalination plants is of the order of $20 billion which is equivalent to 0.5 years of risk exposure. Even if the cost of energy, pipelines and pump were to cost a further $80 billion, this would be 2.5 years of the current risk exposure. It doesn't have to be built in this time and a longer timeframe of 10 years would reduce the cost to a manageable budgetary level for Government.
10. Providing an alternative allows for potential population growth within the Sydney basin without endangering the water supply, the World Heritage area or its associated environmental, historical and indigenous qualities.

There is a need for a multidisciplinary study for assessing the option of desalination as a replacement for the water supply provided by raising the dam and for assessing the best locations for desalination plants offshore and pipeline routes to the West of the State.

Conclusion

The project as presented in the EIS does not control risk and represents a reactive response to loss of the dam wall. The strategy in the EIS project endangers World Heritage status, risks endangered species, the ecosystem and loss of European and Indigenous heritage. It does not serve the people of NSW and should be reviewed against a set of options that would give the Government a long term sustainable water supply.

The example that has been described in this report based on offshore desalination counteracts all the losses that are associated with the current project proposal. The Option delivers a sustainable future that combats both the natural drought and flood cycles.

A simple cost benefit analysis of catastrophic impacts against the provision of offshore desalination indicates the option is safer and more advantageous for the Government. It can be a solution that removes 'moral hazard' related to the DPIE and delivers sustainability, climate mitigation and protects the population.

It is recommended that options are available through a number of high-quality studies which would lead to the NSW Government being recognised world-wide in delivering long term sustainability in the environment and protecting the population against foreseeable catastrophic failures in dam engineering.