Submission No 237

INQUIRY INTO PROPOSAL TO RAISE THE WARRAGAMBA DAM WALL

Organisation: NSW Government

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NSW Government submission to the Legislative Council Select Committee Inquiry on the proposal to raise the Warragamba Dam wall

Infrastructure NSW

WaterNSW

Department of Planning, Industry and Environment

NSW State Emergency Service

Office of Emergency Management

Transport for NSW

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1 Introduction and Inquiry Terms of Reference

This is the NSW Government submission to the Legislative Council Select Committee Inquiry on the proposal to raise the Warragamba Dam wall. No final investment decision relating to the proposal has been made. The decision will be informed by the outcome of the environmental assessment process, currently under way, and the NSW Government assessment of a Final Business Case.

1.1 Delivering the Flood Strategy

The organisations contributing to this submission share responsibility for delivering *Resilient Valley, Resilient Communities* Hawkesbury-Nepean Valley Flood Risk Management Strategy[1] (Flood Strategy). They are:

- Infrastructure NSW
- WaterNSW
- Department of Planning, Industry and Environment
- NSW State Emergency Service
- Office of Emergency Management
- Transport for NSW.

Infrastructure NSW is responsible for overseeing the delivery of Phase 1 of the Flood Strategy (2016-2020). As flood risk management requires a multi-disciplinary and whole-of-government approach, Infrastructure NSW is also responsible for leading specific outcomes under the Flood Strategy:

- **Outcome 1:** Coordinated flood risk management across the valley
- **Outcome 4**: Accessible contemporary flood risk information
- **Outcome 5**: An aware, prepared and responsive community
- **Outcome 6**: Improved weather and flood predictions
- **Outcome 9**: Ongoing monitoring and evaluation, reporting and improvement of the Flood Strategy.

WaterNSW is a State Owned Corporation established under the *Water NSW Act 2014*. As the owner and operator of Warragamba Dam, WaterNSW is the lead for Flood Strategy **Outcome 2** to prepare comprehensive Environmental Impact Statement (EIS) and detailed concept designs for the proposal to raise Warragamba Dam for flood mitigation.

Transport for NSW and the NSW Department of Planning, Industry and Environment are responsible for **Outcome 3** of the Flood Strategy to deliver strategic and integrated land use and road planning to manage risk in the Hawkesbury-Nepean Valley. See **Section 1.2** for an overview of the NSW land use planning context.

The NSW State Emergency Service is responsible for emergency planning for response to floods. The Office of Emergency Management is responsible for planning for recovery from all hazards, including flood. Together the NSW State Emergency Service and the Office of Emergency Management are responsible for Flood Strategy **Outcome 7**: Best practice emergency response and recovery.

[1] *Resilient Valley, Resilient Communities* Hawkesbury-Nepean Valley Flood Risk Management Strategy 2017 https://www.hawkesbury.nsw.gov.au/__data/assets/pdf_file/0018/93051/Infrastructure-NSW-Resilient-Valley,-Resilient-Communities-2017-January.pdf

Transport for NSW is responsible for state and regional road planning and is leading Flood Strategy **Outcome 8:** Adequate local roads for evacuation, and delivering evacuation route signage under **Outcome 5:** An aware, prepared and responsive community.

1.2 New South Wales land use planning context

The NSW Department of Planning, Industry and Environment shares responsibility for strategic planning and development in NSW with the Greater Sydney Commission and councils under the provisions of the *Environmental Planning and Assessment Act 1979*.

Within the Sydney basin the Department works within the strategic planning framework created by *Sydney Region Plan: A Metropolis of Three Cities* and the District Plans prepared by the Greater Sydney Commission. The Department has direct responsibilities to take and assess proposals for State Significant Development and State Significant Infrastructure, with all other development types typically taken and assessed by councils.

The NSW Department of Planning, Industry and Environment is also responsible for the NSW Government's Flood Prone Land Policy, the Floodplain Development Manual and associated floodplain risk management guidelines and tools to help councils manage flood risk including the Floodplain Management Program.

1.3 Terms of Reference and responses

A Legislative Council Select Committee was established on 20 June 2019 to inquire into and report on the NSW Government's proposal to raise the Warragamba Dam wall. The terms of reference and the sections of this submission that address the terms of reference are outlined below.

Terms of Reference	Response
a) conflicting reports on the planning height for the dam wall raising and the potential use of the raising for additional storage capacity as well as flood mitigation,	4.1 The Proposal 4.2 The proposal will not increase water supply storage
b) plans for future property development on flood prone land on the Hawkesbury Nepean Floodplain,	5 Managing development – Flood Strategy Outcome 3
c) engagement between the NSW Government and the World Heritage Committee of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) in relation to the project,	4.5 Engagement between the NSW Government and the World Heritage Committee of the United Nations Educational, Scientific and Cultural Organisation (UNESCO)
d) the adequacy of the Environmental Impact Assessment process to date, including the assessment of impacts on: (i) World Heritage, (ii) Aboriginal Cultural Heritage, (iii) ecological values of the Greater Blue Mountains National Park, (iv) the Warragamba community, (v) communities on the Hawkesbury Nepean Floodplain,	4.3 Warragamba Dam Raising proposal assessment process 4.4 EIS methodology
e) the nature and extent of the examination of alternative options for flood management that formed the basis of the Cost Benefit Analysis of the project and the 'Resilient Valley, Resilient Communities' strategy,	3.3 Assessing existing flood risk and options to reduce risk 3.4 Options assessed 3.5 Findings of the options assessment 4.6 Why creating a 14 metre flood mitigation zone at Warragamba Dam is the preferred infrastructure option
f) the flood risk assessment and proposed flood management of the Hawkesbury-Nepean Valley and whether this meets international best practice standards,	2 Flood risk in the Hawkesbury-Nepean Valley 3.1 Flood Strategy development milestones 3.2 Flood Strategy development approach – flood risk assessment and management 6 Other Flood Strategy Outcomes
g) the estimated cost of the project and identified funding sources,	4.7 Cost of proposal
h) the implementation of recommendations in the inquiry into the *Water NSW Amendment (Warragamba Dam) Bill 2018* by the Standing Committee on State Development in October 2018, and	7 Implementation of Recommendations of Inquiry into *the Water NSW Amendment (Warragamba Dam) Bill 2018*
i) any other related matter	

2 Flood risk in the Hawkesbury-Nepean Valley

Insurers describe the existing flood risk on the Hawkesbury Nepean floodplain as the most significant and unmitigated community flood exposure in Australia.[2] This high flood risk arises from the river being confined by narrow sandstone gorges, creating rapid, deep flooding over extensive floodplains. The floodplains are home to a large existing population that would be impacted by a major flood.

The Hawkesbury-Nepean floodplain was created by flooding over thousands of years. There have been 130 moderate to major floods in the valley since European settlement. The largest of these happened in 1867, when floodwaters reached around 19 metres above normal river height at Windsor. This caused massive and widespread damage, and resulted in the loss of 13 lives. While there has not been a significant flood in the valley since the early 1990s, more major floods are inevitable. The terminology around the likelihood of flood is outlined in **Box 1**.

The history of flooding in the valley is characterised by periods of frequent, higher floods that can be followed by periods dominated by infrequent, smaller floods. This pattern has been described as flood-dominated and drought-dominated regimes. These cycles typically last from 30 to 50 years (**Figure 1**). We are currently around 30 years into a drought-dominated period. The relative absence of floods since 1991 is in no way an indication of future flooding. This is why it is important to plan for floods now. For example, immediately before the recent major flooding in Townsville (2019), the community was on Level 3 water restrictions due to drought.

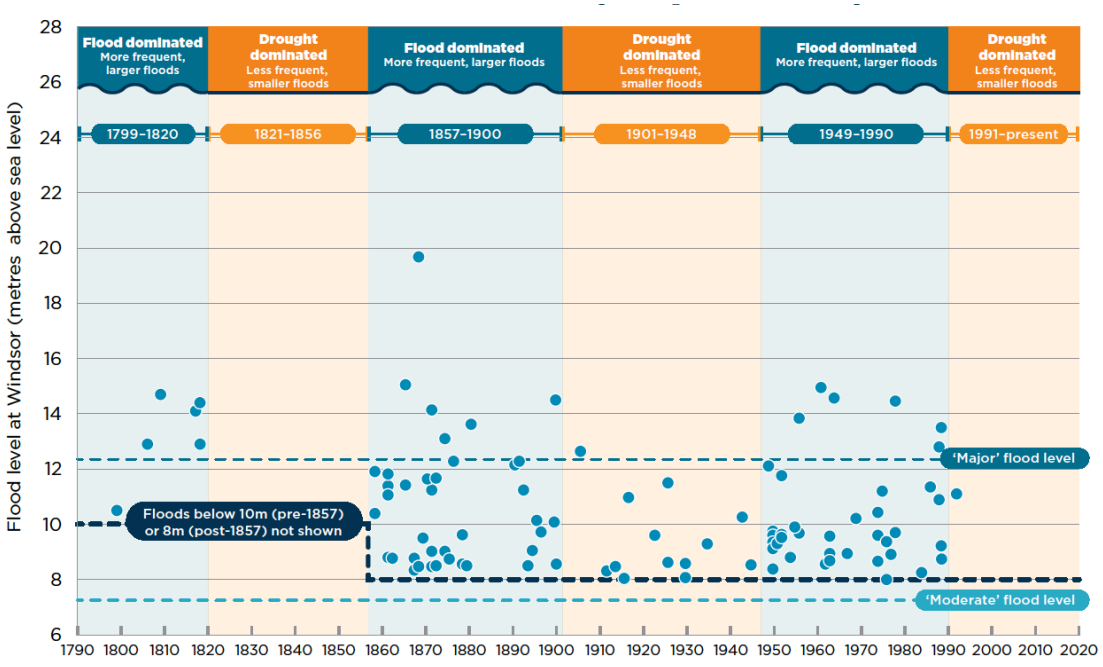


Figure 1 Hawkesbury-Nepean floods at Windsor 1790 to present

[2] Insurance Council of Australia, 3 October 2018.

The Hawkesbury-Nepean Valley consists of large upstream catchments and a series of narrow downstream sandstone gorges. This combination results in floodwaters backing up behind these natural 'choke points' as water enters the system faster than it can escape. Floodwaters rise rapidly, causing significant flooding both in terms of area and depth. As floodwaters rise, flood islands form in the undulating landscape. If floodwaters continue to rise, the flood islands can be completely inundated.

The narrow exit for floodwaters also means that flooding may be prolonged. In the worst recorded flood in the valley, water levels at Windsor exceeded 13.5 metres above normal river level for nearly four days.[3]

Videos explaining the flood risk in the Hawkesbury-Nepean Valley and images from historical floods are available at https://www.ses.nsw.gov.au/hawkesbury-nepean-floods.

2.1 Flood risk to life

Many of the significant urban centres in the valley, including Windsor, Richmond, Bligh Park and McGraths Hill, can become isolated on flood islands as roads are cut. Some of these islands may then become fully submerged as the waters rise during a catastrophic flood event. This would put many lives at risk, particularly if a significant number of people do not respond to evacuation orders. Potential impacts are summarised in **Figure 2**.

Recent research undertaken by Infrastructure NSW confirmed that 3% of the people who live in the floodplain would refuse to leave when told to evacuate, and 27% would use their own judgement.

If a flood similar to the 2011 Brisbane flood occurred in the Hawkesbury-Nepean Valley today, around 64,000 people would need to evacuate from the valley. Even if only 3% failed to evacuate, around 2,000 people would be risking their lives. This number could be much higher in larger floods.

Experience in the recent catastrophic floods at Townsville was that almost 50% of residents did not comply with evacuation orders despite very clear directions to do so.[4]

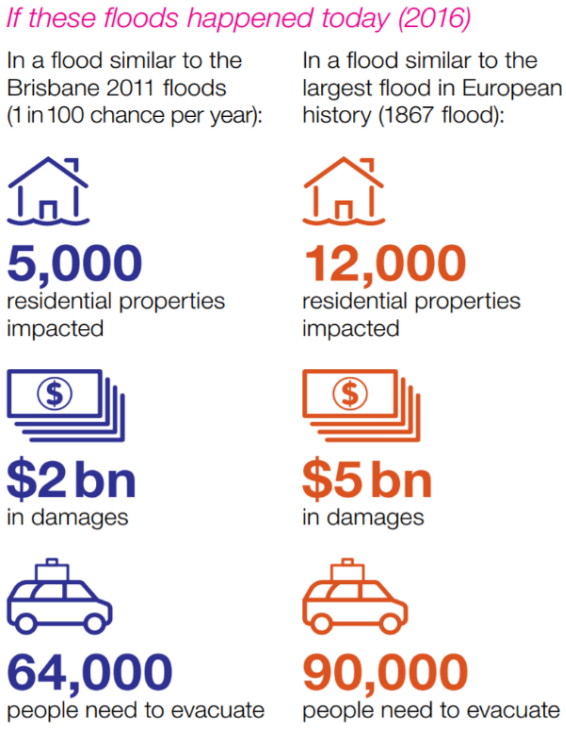


Figure 2 Potential impacts of flood in the Hawkesbury-Nepean Valley[1]

[3] Yeo et al., 2017

[4] Dr Yetta Gurtner, James Cook University Centre for Disaster Studies, 2019

2.2 Flood risk to homes and businesses

Historic European settlement in the Hawkesbury-Nepean Valley over the last 200 years has resulted in a very significant existing flood risk. Based on the mapping, modelling and analysis that informed the Flood Strategy, 25,000 residential properties and two million square metres of commercial space are currently subject to flood risk. These figures are currently being updated with the latest census results and property data.

Our analysis shows that many vital services such as electricity, water, sewerage and telecommunications are also vulnerable at these low points. Cyclonic East Coast Low conditions that lead to most flood events in the valley mean that flooding could last for several days with a potential for significant disruption to services. Depending on the size of the flood, restoration of essential services could take days, weeks or months.

Flood risk in the valley is currently reflected in insurance premiums, with floodplain residents reporting significant increases in their insurance premiums. The Insurance Council of Australia has advised that, in assessing flood insurance, insurers take account of how often a property is expected to flood, how severe the flooding may be, and how deep the flood can get.

The Insurance Council of Australia has advised that, should the Warragamba Dam raising be approved and built, reductions in flood risk at each individual property will be considered by insurers and will typically result in reduced insurance premiums. They further stated that, where effective flood mitigation has been completed in other states, significant reductions in insurance premiums have been achieved.

Box 1 Likelihood of floods

Floods are natural hazards and most often described in terms of the chance that floods of a certain size could occur. The terms '1 in 100 flood', or '100-year flood' refers to a flood that has a 1 in 100 (or 1%) chance of happening or being exceeded in any one year.

It does not mean that this flood will only occur once every hundred years.

For example, every year there is a 1 in 100 chance (or 1% chance) there would be a flood reaching around 17 metres or higher above the normal river level at Windsor.

Expressed another way, it means a person living to 80 years of age has a 55% chance of experiencing this type of flood during their lifetime.

The worst possible flood is often referred to as the 'Probable Maximum Flood' (PMF). Between the 1 in 100 chance per year flood and the worst possible flood, there are numerous other flood probabilities. It is also possible to have a number of different flood events in one year.

3 Flood Strategy to respond to the flood risk

3.1 Flood Strategy development milestones

Recognising the complexities of regional flooding in the Hawkesbury-Nepean Valley and the need for a coordinated approach, the NSW Government has invested significantly to better manage the flood risk to lives, homes, business and community assets.

In response to the NSW Government's adoption of the *State Infrastructure Strategy 2012–2032*[5] and ongoing community concerns about flood risk, the *Hawkesbury-Nepean Valley Flood Management Review* commenced in early 2013. The 2013 Review assessed existing flood management and planning arrangements in the Hawkesbury-Nepean Valley (the valley) to identify ways in which flood risk could be more effectively managed.

The 2013 Review concluded that no single mitigation option can address all the flood risk in the valley, and that raising Warragamba Dam to temporarily capture floodwaters is the infrastructure measure that most significantly reduces and delays regional floods that have the greatest impact on risk to life and damage to homes and businesses.

In May 2014, the NSW Government established the Hawkesbury-Nepean Valley Flood Management Taskforce (the Taskforce) to advance the work of the 2013 Review. This interagency group investigated feasible infrastructure and non-infrastructure options to reduce overall flood risk in the valley.

The Taskforce recommendations were adopted by the NSW Government in June 2016 and incorporated into Resilient Valley, Resilient Communities: Hawkesbury-Nepean Valley Flood Risk Management Strategy (the Flood Strategy) [6], released in May 2017. The Flood Strategy outlines the methods used to assess flood risks, the options evaluated, and nine key outcomes to be implemented to achieve the objective and vision outlined in **Box 2** below. Phase 1 of the Flood Strategy is currently being implemented.

Box 2: Flood Strategy Vision and Objective

Vision: Hawkesbury-Nepean Valley communities and all levels of government are resilient to and will adapt to flooding by working together to:

- understand and be fully aware of flood risk
- act to reduce flood risk and manage growth
- be ready to respond and recover from flooding.

Objective: To reduce flood risk to life, property and social amenity from regional floods in the Hawkesbury-Nepean Valley now and in the future.

[5] http://www.infrastructure.nsw.gov.au/media/1127/sis_report_complete_interactive.pdf
[6] Flood Strategy fact sheets and frequently asked questions can be found at http://www.infrastructure.nsw.gov.au/expert-advice/hawkesbury-nepean-flood-risk-management-strategy/

3.2 Flood Strategy development approach – flood risk assessment and management

The Flood Strategy is based on four years of extensive assessments, including the work of the Review in 2013 and the Taskforce (2014-2016). The Taskforce Options Assessment Report brings together data and analysis from investigations and reports undertaken over the four years. It synthesises into one document the approach, methodology, processes and outcomes of the assessments. The full report is available on the Infrastructure NSW website at insw.com/flood.strategy.[7]

Best practice strategic flood risk assessment and management approaches were applied in developing the Flood Strategy, informed by the 2011 National Strategy for Disaster Resilience which puts the onus on governments to:

- develop risk-based land management and planning arrangements and mitigation activities,
- effectively inform people about their risk and how to manage it, and to have education systems in place, and
- ensure the most effective emergency response.

Options to address all these elements were assessed and included in the Flood Strategy.

The Flood Strategy is also aligned with the broader emergency management framework as set out in the *State Emergency and Rescue Management Act 1989.* That is, to work to prevent, prepare, respond and recover from floods. The alignment of Flood Strategy outcomes to this framework is outlined in **Figure 3.**

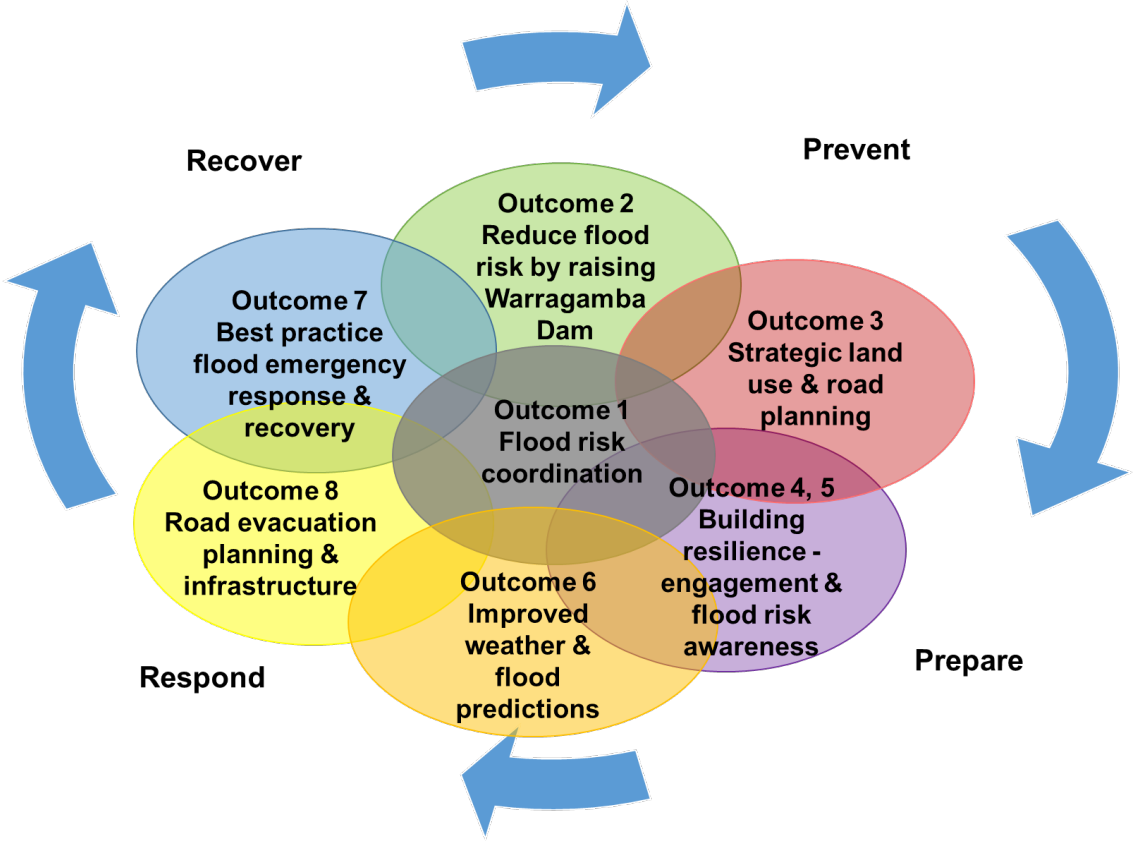


Figure 3 Flood Strategy Outcomes comprehensively cover the Emergency Management Cycle

[7] www.infrastructure.nsw.gov.au/media/1976/taskforce-options-assessment-report-2019-v2.pdf

The Flood Strategy was developed following a thorough process of flood risk assessment informed by the Australian Institute for Disaster Resilience Handbook 7, Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR, 2017) and the Floodplain Development Manual (NSW Government, 2005).

The Taskforce's methodology adopted an evidence-based approach to understand existing flood risk (2016 base case) and future flood risk (in 2041) without any risk treatment. The information on the existing risk profile was then used to assess the efficacy of infrastructure and non-infrastructure options to better prevent, prepare for, respond to and recover from floods for a more flood resilient valley.

This approach acknowledges that the level of exposure to flood risk, and resilience of communities (both human and natural), changes over time. The key drivers of change include population growth, climate change and the future use of new technology.

All potential infrastructure and non-infrastructure options to reduce flood risk in the valley were assessed. This work informed the integrated mix of infrastructure and non-infrastructure actions included in the Flood Strategy.

The Flood Strategy adopts an adaptive management approach recognising that our understanding of risk improves with new information, methods and technologies. This means that monitoring, evaluation and expert peer review is built into the strategy.

3.3 Assessing existing flood risk and options to reduce risk

Flood risk was assessed by estimating the potential risk to life and adverse impacts on the economy and social amenity across the full range of possible flood events. This methodology included:

1. Flood modelling to quantify the likelihood and behaviour of floods – around 20,000 flood events were generated to characterise the full range of flood risk. This represents the range of floods that could be experienced over a 200,000 year period.
2. Developing a floodplain assets database to define current and potential future exposure that records the location of all residential property and essential assets.
3. Quantifying the potential consequences from floods for the current and future flood risks by estimating the:
    - risk to life using a purpose built, 'agent-based' flood evacuation model developed by the CSIRO. The model estimated the number of vehicles that were unable to evacuate for different floods under a combination of population, dam and road upgrade scenarios. More than 13,000 model runs were generated to simulate evacuations under a broad range of conditions.
    - social research to understand the broader community's level of flood risk awareness and preparedness.
    - potential impacts on the economy and social amenity using a flood damages assessment.

3.4 Options assessed

There is a range of options to manage flood risk across the flood risk management cycle, **Figure 1**. They fall into two broad categories:

Category 1: Infrastructure options can significantly reduce flood risk by lowering the chance of a flood event occurring, reducing the exposure of homes and business to flood, and with some

options, increasing the certainty of time for evacuation. Infrastructure options assessed by the Taskforce included:

- controlling flows into the floodplains (options assessed included new dams or changing existing Warragamba Dam either through operation, e.g. lowering the water supply level, or raising the wall)
- protecting areas within the floodplains (over 30 levees were assessed)
- reducing the constriction of the sandstone gorges (diversion channels, and river dredging were assessed)
- increasing evacuation capacity (large scale regional and smaller road upgrades were assessed)
- upgrading drainage to prevent premature closure of local and state roads.

Category 2: Non-infrastructure options address different elements of the flood risk management cycle (**Figure 3**). They are essential elements of best practice to manage ongoing risk and to help ensure that the benefits of any infrastructure options are maintained over time. Non-infrastructure options assessed include:

- helping to prevent exposure through integrated land use planning and appropriate flood planning controls by matching development potential to evacuation capacity
- reducing flood risk exposure through voluntary house purchase, where appropriate
- increasing community awareness, preparedness and response
- increasing flood warning time through meteorological forecasting upgrades
- improving emergency and recovery planning and response
- strengthening the integration and coordination of organisations responsible for floodplain management.

3.5 Findings of the options assessment

Table 1 summarises the options considered and why they were either taken forward into the Flood Strategy or not progressed.

Non-infrastructure options were assessed based on their contribution to the 'prevent, prepare, response and recovery' aspects of flood risk management - as well as the extent to which they contributed to the maintenance of flood mitigation benefits of infrastructure options over time.

Flood infrastructure options were assessed based on their ability to:

- significantly reduce the risk to life to downstream communities, and
- provide greatest net regional benefits (**Box 2**).

Flood infrastructure options such as dams, localised levees and drainage works were assessed in terms of their costs and benefits, including a preliminary analysis of socio-economic, environmental and cultural-heritage impacts. The flood infrastructure option selected to progress to a thorough analysis and design is the raising of Warragamba Dam by creating a 14 metre flood mitigation zone. This assessment is further detailed in the following section.

Table 1 Assessment of flood mitigation options across 'prevent, prepare, respond and recover'

Flood management options	Prevent*	Prepare	Respond	Recover	Outcome	Key reason(s)
Infrastructure measures						
Surcharge existing dam gates during floods	✓				Not supported	Does not provide significant, regional reduction of flood risk
Pre-release water before forecast flood events	✓				Not supported	Does not provide significant, regional reduction of flood risk; risk of loss of water supply
Permanently lower full water supply level by 5m	✓				Not supported	Does not provide significant, regional reduction of flood risk; loss of water supply
Permanently lower full water supply level by 12m	✓				Not supported	Provides moderate regional benefits in critical flood range but has high net cost due to high costs of addressing permanent water supply loss and likelihood of more frequent water quality issues.
New flood mitigation dams upstream of Warragamba	✓				Not supported	High social, environmental & cultural heritage impacts; no sites as well suited as Warragamba
New flood mitigation dams downstream of Warragamba	✓				Not supported	Does not mitigate predominant Warragamba catchment floods
Raise Warragamba Dam wall to create a 14 metre flood mitigation zone	✓				**Supported**	Provides significant, regional reduction of flood risk; highest net benefit of all options considered
Raise Warragamba Dam wall to create a 20 metre flood mitigation zone	✓				Not supported	Provides greatest flood mitigation but has lower net benefit than +14m; higher relative impacts from temporary upstream inundation and downstream post flood releases.
Currency Creek diversion channel	✓				Not supported	Does not provide significant, regional reduction of flood risk; high net cost; high-extreme environmental impact
Sackville cut-off (short diversion)	✓				Not supported	Does not provide significant, regional reduction of flood risk
Sackville large diversion	✓				Not supported	Does not provide significant, regional reduction of flood risk. Extreme cost; likely extreme environmental impact
Dredging between Windsor and Wisemans Ferry	✓				Not supported	Does not provide significant, regional reduction of flood risk. High net cost; high-extreme environmental impact; must be maintained for ongoing flood mitigation
Levees (Peachtree Creek, McGraths Hill, Pitt Town)	✓				Not supported	Provides local benefit only and not for severe or catastrophic floods
Regional evacuation road upgrades (>10 major packages assessed)			✓		Not supported	Even with multiple major road upgrades, still less effective at reducing risk to life than dam raising; high net cost since does not reduce property damages – provides capacity for evacuation only.
Local evacuation road upgrades			✓		**Supported**	Improves local evacuation, complementing existing regional evacuation routes
Non-infrastructure measures						
Voluntary house purchase (VP)	✓				Not supported	Extreme cost (billions) to significantly reduce flood risk; extreme social disruption requiring mass relocation
Voluntary house raising (VHR)	✓				Not supported	Impractical due to building styles and extreme flood depths in this valley
Flood risk-based regional land use planning	✓				**Supported**	Essential and complementary to dam raising; limits increase in future exposure; manages impact of growth on evacuation capacity
Flood risk-based regional road planning			✓		**Supported**	Road Evacuation Master Plan will consider flood evacuation risk when regional roads are upgraded for growth in the valley
Improved flood forecasting and warning system			✓		**Supported**	Complementary to infrastructure measures; provides increased certainty of time for evacuation
Community flood awareness, preparedness and responsiveness		✓	✓		**Supported**	Complementary to infrastructure measures; critical component for successful evacuation and resilient communities
Best practice emergency response and recovery		✓	✓	✓	**Supported**	Complementary to infrastructure measures; critical for optimum decision making, rescue capacity, efficient recovery etc
Improved governance to support integrated flood risk management	✓	✓	✓	✓	**Supported**	Coordination of flood risk management in valley
Collection of post-event flood data/intelligence	✓	✓	✓	✓	**Supported**	Continuous improvement of flood models, emergency response and recovery plans

* In the strict sense, flood mitigation measures and measures that target exposure such as land use planning can reduce or manage the risk but not prevent it

4 Flood Strategy Outcome 2: Proposal to raise Warragamba Dam for flood mitigation

4.1 The Proposal

The main water sources contributing to Hawkesbury-Nepean River flooding are:

- Warragamba River
- Upper Nepean River
- Grose River
- Colo River
- South Creek
- Macdonald River.

Warragamba Dam is on the Warragamba River, around three kilometres upstream of its junction with the Nepean River. The 9,000 square kilometre Warragamba Catchment contributes the majority of flows to the most dangerous and damaging floods in the Hawkesbury-Nepean Valley. Historically, the Warragamba River has contributed up to 70% of the flows during major floods. Modelling for the Flood Strategy shows that the Warragamba River can contribute as much as 75% of flows during major events.

WaterNSW is the owner and operator of Warragamba Dam, and has the lead for **Outcome 2** to complete detailed concept design and costing for the raising of Warragamba Dam wall and to prepare an Environmental Impact Statement.

The proposal is to raise Warragamba Dam by creating 'airspace' in a dedicated 14 metre flood mitigation zone above the current full supply level of the dam. This would allow floodwaters coming from the large Warragamba Catchment to be temporarily held back and then released in a controlled way.

This would delay and reduce the flood peak and flood extent for downstream communities, and allow more time for evacuation – reducing the risk to lives, flood damages and social disruption caused by major floods in the valley. It would reduce flood damages by 75% on an annual average basis.

Raising Warragamba Dam to create the 14-metre 'flood mitigation zone' involves:

- increasing the level of the dam's central spillway by approximately 12 metres, and
- increasing the dam abutments (or side walls) and road bridge by up to 17 metres.

Temporary inundation of the areas upstream of the dam, including World Heritage Areas, occurs now in a flood with the existing dam. Based on the proposed raising, the additional temporary inundation upstream would be up to 14 metres higher than it would currently reach in an equivalent sized flood event today. This is determined by the height and configuration of the spillways, not the height of the side walls.

Raising of the dam's abutments by up to 17 metres is being incorporated in the dam design for dam safety reasons, i.e., to allow the proposed raised dam to safely pass the most extreme possible flood used for dam design.

4.2 The proposal will not increase water supply storage

The proposal to raise Warragamba Dam for flood mitigation does not involve increased water supply storage.

The flood mitigation zone created by the raised dam would only be used to temporarily detain floodwaters during floods for up to around 14 days.

The detailed design and environmental assessment currently being prepared by WaterNSW does not consider water supply storage increases. Any water supply increase would require a new environmental impact assessment and planning approvals as it would result in permanent inundation upstream. It would also require legislative amendment to permit permanent inundation.

4.3 Warragamba Dam Raising proposal assessment process

As State Significant Infrastructure, the proposal requires planning approval from the Minister for Planning and Public Spaces in accordance with the *Environmental Planning and Assessment Act 197*9 (NSW) (EP&A Act). The project will also require approval from Australian Government Minister for the Environment, who would consider NSW Department's assessment report following determination of the application.

The Warragamba Dam raising proposal will be assessed by the Department of Planning, Industry and Environment under the bilateral agreement between the NSW and Australian Governments, in accordance with the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999*.

On 13 March 2018, the Department of Planning, Industry and Environment issued the Planning Secretary's environmental assessment requirements (SEARs) to the applicant. [8] The SEARs require WaterNSW to prepare an Environmental Impact Statement (EIS) that assesses environmental impacts, including but not limited to impacts on Aboriginal and non-Aboriginal heritage, biodiversity, local amenity, and matters of national environmental significance, including world heritage and threatened species and communities.

WaterNSW is currently preparing the EIS documentation including supporting reports. Adequacy of the EIS, including compliance with the SEARs, will be assessed by the Department of Environment, Industry and Environment once lodged.

Opportunity for the community to make comment on the EIS will be encouraged as part of the public exhibition and consultation in 2020. All community members will be able to view the EIS during the display period and make a submission about what matters to them. Submissions will be addressed as part of the subsequent Preferred Infrastructure Report.

[8] Secretary's Environmental Assessment Requirements: https://majorprojects.accelo.com/public/7636122903f88cbb759f65eac95f760f/SSI%208441%20-%20SEARs%20[As%20Revised%2013%20March%202018].pdf

4.4 EIS methodology

The environmental impact assessment process will comprehensively consider all known possible impacts. While the dam raising proposal will have very significant community benefits, the Government recognises that decision-makers must fully understand the potential environmental and social impacts, and how they may be managed, mitigated or offset as part of the project design and operation. The methodology for key areas of assessment are outlined below.

4.4.1 World Heritage

The impact on the World Heritage Area is being assessed as part of the EIS against the objectives set out in the Greater Blue Mountains World Heritage Area 2009 Strategic Plan. The assessment will consider the proposal against the individual criteria from the Strategic Plan around key areas, including; World Heritage values, other identified values, threats, strategic and key management objectives. See **Section 4.5** for further information on engagement with the World Heritage Committee of the United Nations Educational, Scientific and Cultural Organisation (UNESCO).

4.4.2 Aboriginal Cultural Heritage Assessment

The Aboriginal Cultural Heritage Assessment is a vital part of the environmental assessment process. The EIS prepared for the Warragamba Dam Raising proposal will have a section dedicated to assessing the proposal's effect on Aboriginal cultural heritage.

Regular and ongoing consultation with Aboriginal communities is being undertaken in accordance with the *NSW National Parks and Wildlife Act 1974,* and relevant regulations and guidelines. This includes the *Aboriginal Cultural Heritage Requirements for Proponents 2010* that establishes a process to consult any Aboriginal people who hold cultural knowledge relevant to, or who have a right or interest in determining the cultural heritage significance of Aboriginal objects and places in the potentially impacted area.

Identification of and consultation with the Aboriginal stakeholders has been undertaken in compliance with the legislative requirements and guidelines. All twenty-two organisations and individuals who applied to be considered Registered Aboriginal Parties for the proposal were accepted, the primary requirement for which is to demonstrate a connection to land and/or culture of the area potentially impacted by the project**.**

The Aboriginal Cultural Heritage Assessment is being supported by specialist archaeologists. Following early discussions with the Gundungurra Indigenous Land Use Agreement Consultation Committee, WaterNSW engaged an additional Aboriginal heritage consultant to participate in conducting the survey - selected by the traditional custodians with links to the Gundungurra People and specialised knowledge of Aboriginal heritage in the Blue Mountains region.

The assessment methodology detailed in the Aboriginal Cultural Heritage Assessment report was designed to provide a representative sample of the proposal area. Prior to undertaking the site surveys, the methodology was developed in consultation with the Registered Aboriginal Parties. The survey sampled each of the landforms within the Subject Area to identify the types of Aboriginal sites that may be present within these landforms.

Registered Aboriginal Parties were key participants in all site surveys undertaken with archaeologists. The surveys took place over 72 days between May 2018 and June 2019 to compile information about the cultural significance and values of the Burragorang Valley area that may be impacted. Sites were surveyed outside of the impact area to inform broader cultural context of the Burragorang Valley.

A consultation draft of the Aboriginal Cultural Heritage Assessment Report was provided to the Registered Aboriginal Parties for their review and comment as per the draft *Aboriginal Cultural Heritage Requirements for Proponents 2010* to seek input on mitigation and management measures and treatment of the cultural sensitive information in the EIS. A period of 42 days was allowed for this feedback instead of the 28-day mandatory period. As the draft report contains culturally sensitive information it was not distributed beyond the Registered Aboriginal Parties.

The sites which have been identified to date will also be submitted to the Department of Planning, Industry and Environment for inclusion in the Aboriginal Heritage Information Management System.

The feedback received from Registered Aboriginal Parties on the draft report is informing the EIS section on Aboriginal Cultural Heritage and the final Aboriginal Cultural Heritage Assessment.

The final Aboriginal Cultural Heritage Assessment Report will form part of the EIS which will be placed on public exhibition. Traditional custodians will determine the extent of any culturally sensitive information that will be available in public-facing documents. There will be further opportunity to provide feedback on the assessment and the proposed mitigation and management measures during the public exhibition of the EIS.

4.4.3 Ecological values of the Greater Blue Mountains Area

Comprehensive ecological studies have been undertaken to assess the impacts of a temporary increase in upstream inundation as a result of the proposal to raise Warragamba Dam for flood mitigation. This includes assessing impacts on threatened plant, animals and ecosystems, and identifying measures to mitigate impacts where possible. The findings will inform key elements of the EIS.

4.4.3.1 Wild rivers

The impact of flooding on wild rivers is also being considered. There is one designated wild river in the Warragamba Dam catchment – the Kowmung River. The designated wild river reach starts about 3.3 kilometres upstream of its confluence with the Coxs River and extends upstream. The Wild River stretch of the Kowmung River would not be impacted by the proposal in events up to and including the 1 in 100 (1%) chance per year flood.

4.4.3.2 Biodiversity

Biodiversity surveys have been completed to better understand the flora and fauna, targeting threatened species within the Greater Blue Mountains National Park and larger study area. Over 3000 hours of field surveys have been completed and the impact assessment is being undertaken in accordance with the Framework for Biodiversity Assessment (Department for Planning, Industry and Environment). The findings will be presented in the EIS.

4.4.4 Neighbouring communities

The EIS will assess and seek to mitigate the construction and operational impacts to communities neighbouring Warragamba Dam such as noise, vibration, air quality, traffic movement. During construction, there will be opportunities for local employment, training and provision of services. If the proposal is approved, the construction contractor would be required to provide local employment and business opportunities. The contractor would also be required to develop a framework to increase the representation of young people, Aboriginal and Torres Strait Islander people and women in the construction industry by providing employment pathways, training and skills development.

Early input ahead of the EIS exhibition has been sought from key representatives from the neighbouring communities. The EIS will outline proposed management and mitigation measures for the local community during construction for consultation. If the proposal is approved, there will be further consultation with the local community on the construction management plans and local opportunities associated with the construction phase.

4.4.5 Communities on the Hawkesbury Nepean floodplain

Socio-economic impact assessment of the proposal has been undertaken and will be included in the EIS. This work has been supported by surveys, interviews with key stakeholders, including floodplain councils, and detailed analysis of a broad range of data. The assessment will outline the significant socio-economic benefits to downstream communities from the reduced risk to lives, property, social cohesion and amenity. The methodology used to assess these benefits is outlined in **Section 3.3**.

In operation, the raised dam would control floods by capturing floodwaters in the airspace and slowly releasing them. As a result, there would be incremental increases in the duration of downstream inundation of some low-lying areas in the floodplain as the floodwaters are released following the flood peak. This will be assessed in the EIS.

4.5 Engagement between the NSW Government and the World Heritage Committee of the United Nations Educational, Scientific and Cultural Organisation (UNESCO)

At the 43rd (2019) session of the World Heritage Committee in Azerbaijan, UNESCO's World Heritage Committee requested in relation to the Outstanding Universal Value (OUV) of the Greater Blue Mountains World Heritage Area, that the Australian Government ensure that the EIS *'for the proposal fully assesses all potential impacts on the OUV of the property and its other values, including Aboriginal cultural heritage, and to submit a copy of the EIS to the World Heritage Centre for review by IUCN, prior to taking any final decisions regarding the project'.*

The Australian Government, as the signatory to the World Heritage Convention, is responsible for engaging with the World Heritage Committee. This engagement is managed by Department of Environment and Energy. The Australian Government will respond to the Committee and make the EIS available to the World Heritage Committee when it is released for public exhibition and comment.

The NSW Government acknowledges the concern expressed in the World Heritage Committee decision about potential impacts of the proposed raising of the Warragamba Dam on the Greater Blue Mountains Area.

Any development in or near the World Heritage property is subject to rigorous environmental impact assessment under both State and Federal environment laws which help to protect the world heritage values of the property.

4.6 Why creating a 14 metre flood mitigation zone at Warragamba Dam is the preferred infrastructure option

The proposal to raise Warragamba Dam for flood mitigation is effective because it delays and lowers downstream flood levels to:

- reduce risk to life by reducing the number of floods that trigger evacuations, **Figure 3**
- increase the certainty of time for evacuation for the floods that still require evacuations, **Figure 3**
- significantly reduce flood damage to homes and businesses by 75% on average.

The Taskforce's detailed modelling work and assessment of options over four years has shown that mitigating floods between the 1 in 50 to 1 in 1,000 chance per year is the most effective to reduce risk to life and property (**Box 3**). Creating a 14 metre flood mitigation zone at Warragamba Dam would provide significant and cost-effective regional risk reduction in this critical flood range, while balancing upstream impacts. It also reduces flood levels by up to four metres in the critical range for the high-risk flood islands, depending on the location and size of the event.

The 14 metre raising would also provide benefits for the worst possible flood, which is an extremely rare event with approximately a 1 in 100,000 chance per year of happening. In such an event, it would reduce flood the levels by up to two metres depending on the location. However, significantly mitigating the most extreme events rather than those in the critical range would require a much larger flood mitigation zone. This would result in larger and longer temporary upstream impacts, and, based on the Taskforce's cost benefit analysis, would not be as cost effective as the proposed 14 metre flood mitigation zone (**Figure 5**).

Box 3 Critical range for flood risk reduction – 1 in 50 to 1 in 1000 chance per year events

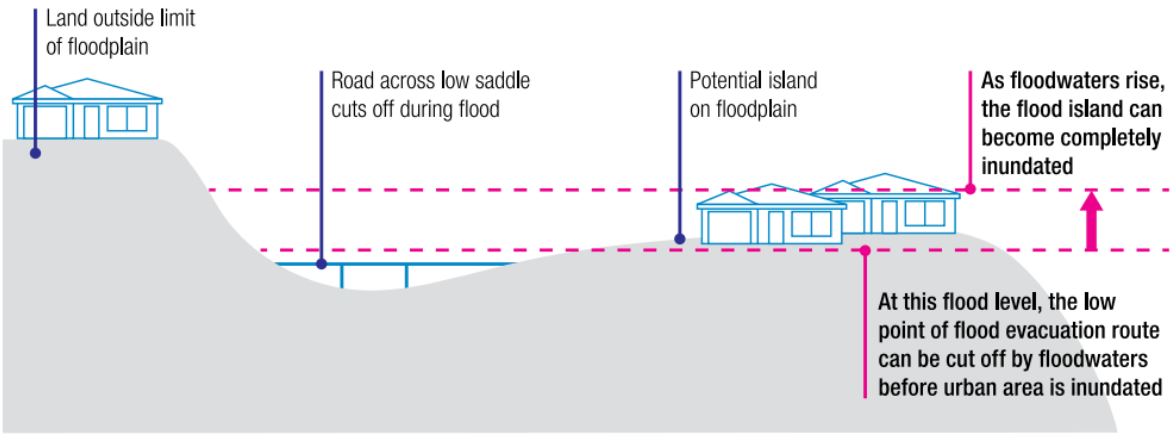
Flood islands are areas that are isolated by floodwaters during the flood event. These islands may become fully inundated in large floods, **Figure 4**. Many of the significant urban centres in the floodplain - such as McGraths Hill, Windsor, Richmond and Bligh Park - are located on these flood islands.

Due to the depth of flooding and the distance to safety, there is potential for significant fatalities if evacuation is not successful from the flood islands.

Effective flood infrastructure mitigation options are those that significantly reduce peak flood levels particularly in the range of 1 in 50 to 1 in 1,000 chance per year floods. This is because the 1 in 50 to 1 in 500 chance per year flood range contributes about two-thirds of the average annual flood damages. The 1 in 1,000 chance per year flood cuts the last evacuation road isolating Richmond, so it is the last flood level where mitigation has significant benefits in terms of saving lives. By this point major populations requiring evacuation should have left the floodplain.

While some localised low points have been identified for upgrading to support evacuation, it is not feasible to significantly reduce the risk to life across the valley by raising or widening roads alone.

Figure 4 How a flood island can be isolated then fully submerged



As the major flood islands are below the 1 in 1,000 chance per year flood level, higher dam raisings would have limited additional reduction in risk to life. They would also have higher construction costs and greater upstream inundation impacts compared to the proposal to create a 14 metre flood mitigation zone at Warragamba Dam.

The relative benefits of raising the dam (to create a flood mitigation zone of either 14 metres or 20 metres) or permanently lowering the water supply (by either 5 metres or 12 metres) compared to the existing dam is shown in **Figure 5**. For example, with a 14 metre flood mitigation zone, 83% of the modelled events that currently reach the 1 in 100 chance per year flood planning level would no longer reach that level.

The 14 metre option would also provide additional time for evacuation for the remaining events that would reach or exceed that level, with most delayed by 10 or more hours. Creating a 20 metre flood mitigation zone provides greater benefits but is not as cost effective because the incremental benefits over the 14 metre flood mitigation zone are outweighed by the additional costs.

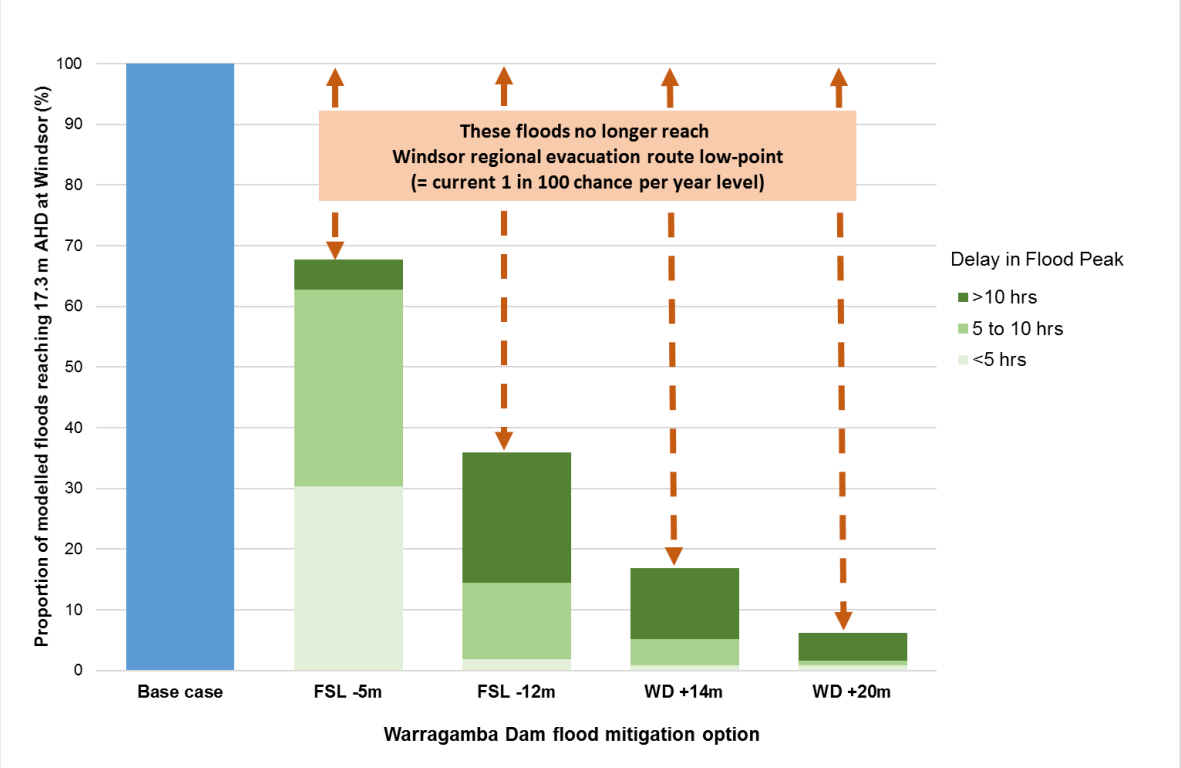


Figure 5 Relative benefits of Warragamba Dam flood mitigation options

4.6.1 Relative contributions from other catchments

The proposal to raise Warragamba Dam for flood mitigation is also effective because the Warragamba Catchment represents around 80% of the catchment at Penrith, and 70% of the catchment at Windsor. Flows from the Warragamba Dam catchment contribute to the floods that pose a significant risk to life, homes and businesses.

The current flood planning level, which is based on the 1 in 100 chance per year flood, is 17.3 metres Australian Height Datum (AHD) at Windsor. This is the level above which residential development is currently permitted. Without flows from the Warragamba Dam catchment, flooding from other rivers and tributaries downstream is extremely unlikely to reach the flood planning level.

In other words, floods resulting from flows only generated by the Nepean and Grose rivers and all other tributaries do not pose as significant risk to risk to life, homes and businesses compared to floods that involve the large Warragamba Catchment.

4.6.2 Impact on insurance

The Insurance Council of Australia has indicated that any reduction in flood risk at individual properties will be considered by insurers, and will typically result in reduced premiums.

The Council also notes that, where effective flood mitigation such as the Warragamba Dam raising proposal have been implemented in other states, there have been significant reductions in insurance premiums.

Reductions in flood insurance premiums would make insurance more affordable for residents in the floodplain. This may lead to an increase in the take up rates for flood insurance, resulting in more households and businesses being better able to financially recover from the impacts of future flood events.

4.6.3 Cost effectiveness

Raising Warragamba Dam by around 14 metres for flood mitigation was recommended in the Flood Strategy as it the most cost-effective infrastructure option, with net benefits of around $200 million (2015), **Figure 6**.

Under the Flood Strategy implementation, the detailed concept design is currently being completed by WaterNSW. This final design will become the basis for the final cost estimate for the raising. A final cost estimate will inform a NSW Government investment decision on the Final Business Case in 2020 (subject to planning approvals).

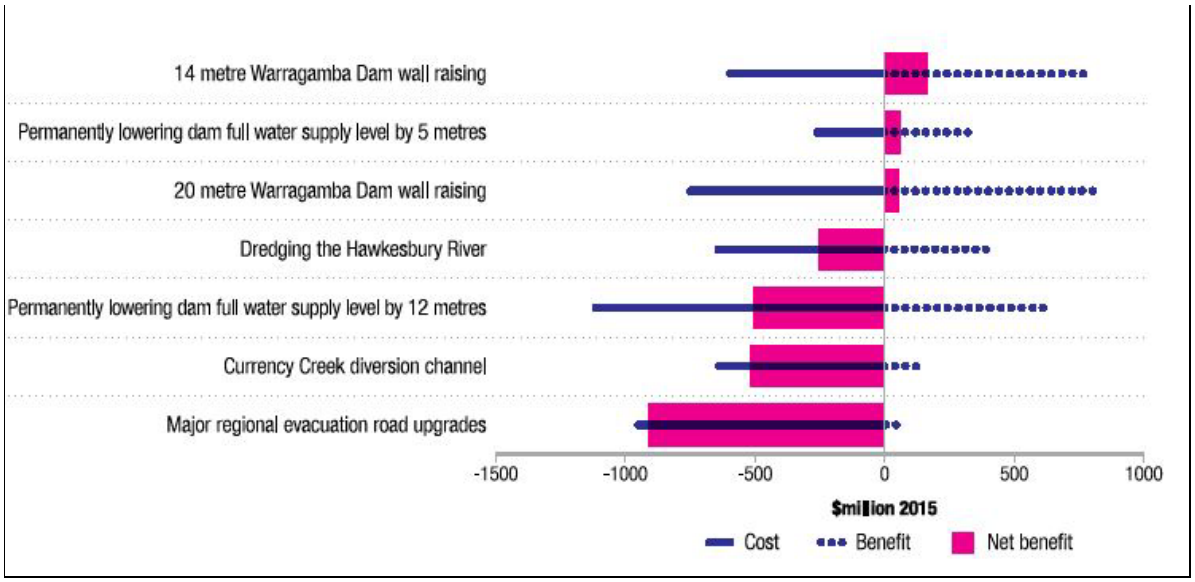


Figure 6 Comparison of creating a 14 metre flood mitigation zone at Warragamba Dam raising with other infrastructure options[9]

[9] https://www.hawkesbury.nsw.gov.au/__data/assets/pdf_file/0018/93051/Infrastructure-NSW-Resilient-Valley,-Resilient-Communities-2017-January.pdf

4.6.4 Assessment of options to lower water supply

Raising Warragamba Dam for flood mitigation is the most effective option because it provides a single point of mitigation for the catchment with the largest contribution to regional floods above the flood planning level (see **Section 4.6**).

An alternative option is to create airspace for flood mitigation by permanently lowering the full water supply level of Warragamba Dam. Warragamba Dam is a water supply dam and currently holds approximately 80% of Sydney's stored water capacity. Options to change the way the existing Warragamba Dam is operated are either not cost effective, or do not sufficiently mitigate the floods that pose the greatest risk to life or property.

In arriving at this conclusion, two options to permanently lower the dam's full water supply to create airspace to capture floods were investigated - five metres, and 12 metres (12 metres is the maximum possible to the depth of the dam spillway crest).

A five metre lowering was found to have relatively limited benefits for the larger floods that pose the most risk to lives and property - reducing flood damages by only 27 percent and the dam's capacity by around 18 percent or 360 billion litres of water.

A 12 metre lowering provides moderate flood mitigation capacity, reducing flood damages by around 60 percent on average. However, due to the deep 'V' shape of the reservoir, it would reduce the dam's capacity by around 40 percent or 795 billion litres of water. To make up for the forgone water, new sources of water would need to be built and the existing desalination plant would need to be operated at its maximum effective capacity. The cost of this option is currently being reviewed.

Reducing water storage would have a significant impact on water security for greater Sydney and on water bills for Sydneysiders. In addition, lowering the dam storage by 12 metres would have environmental and water quality costs, and would have serious implications for the release of environmental flows from Warragamba Dam for downstream river health.

Had this option been implemented before the current drought, Warragamba Dam would be at around 10% capacity (as at end of August 2019). Without the construction of alternative water sources, the city would be at significant risk of running out of water and highly exposed to source water quality risks.

The option to pre-release or discharge water from Warragamba Dam's water supply storage to create a temporary air space to capture inflows before a forecast flood was also examined. Pre-releasing has limited effectiveness – it has some benefits for small floods, but minimal benefits for the larger floods that pose the greatest risk to life and people's homes. This is because it is not possible to safely release enough water based on flood forecasts to create sufficient airspace to mitigate significant floods in the critical range where lives and properties are at risk.

4.6.5 Assessment of road upgrade options

Evacuation needs to occur early in a flood in the valley because many key evacuation routes will be cut off by floods at low points, well before population centres are inundated. For example, in a 1 in 100 (1%) chance per year flood – similar to the 2011 Brisbane flood – Windsor Road, Richmond Road, and Hawkesbury Valley Way will be cut. Hawkesbury Valley Way is the last evacuation road for Windsor. See **Box 1** for an explanation on the likelihood of floods.

Roads, while vital for evacuation, do not reduce the number of people directly exposed to flood. As part of the development of the Flood Strategy, large scale upgrades to increase evacuation capacity

of roads leading away from the floodplain were investigated. Because of the many kilometres of the road evacuation network that would need to be upgraded, and the large number of low points in the roads, billions of dollars would need to be spent on roads to make a significant difference to evacuation rates. There are limits to how high roads and bridges can be raised.

No package of large scale road upgrades was found to be as cost effective as the proposed Warragamba Dam raising for flood mitigation. This is because large scale road upgrades can improve evacuation rates but would not reduce damages to homes and businesses.

4.6.6 Assessment of option to purchase property at risk of flooding

In developing the Flood Strategy, options for voluntary house purchase were examined and were found not to be feasible due to the economic and social cost of relocating whole suburbs. If the 12,000 dwellings that are currently below the level of the 1867 flood, (the largest flood on record) were purchased, this could cost over $10 billion. This estimate is based on an average house price of around $750,000 ($2015) in the main affected Local Government Areas.

4.7 Cost of proposal to raise Warragamba Dam for flood mitigation

The final cost estimate for the proposal will be influenced by the completed detailed design, conditions of planning approval, competitively priced proposals from construction contractors for the project, and contemporary market conditions.

The NSW Government is committed to the completion of the EIS and Final Business Case to fully assess the project on its merits. No final investment decision has been made.

5 Managing development – Flood Strategy Outcome 3

Development in the Hawkesbury-Nepean Valley is the result of both past and present planning practices and Government approvals that date back to the early days of European settlement. The valley includes historic settlements at Windsor, Richmond, Pitt Town, Warragamba and Penrith, as well as newer development areas such as those associated with the North West Growth Centre.

Should the Warragamba Dam raising be approved and built, the flood water level corresponding to the current 1 in 100 chance per year flood would reduce. For example, at Windsor the 1 in 100 chance per year flooding level would reduce from 17.3 metres to around 13.5 metres. However, to ensure the benefits of the dam raising would be maintained over time, the current flood planning area defined by the current 1 in 100 chance per year flood level would continue to apply. This would prevent land below the current 1 in 100 chance per year flood level being opened up for new residential development areas.

5.1 Improved land use planning guidance

The Flood Strategy noted that the population at risk is forecast to increase in the next 30 years. This forecast was based on development that could occur under current land use planning arrangements and zonings. This forecast is not a target, nor is it dependent on the proposed dam raising.

Much of the flood risk relates to homes and businesses between the 1 in 100 chance per year flood level (being the basis for the current flood planning level) and the worst possible flood (the probable maximum flood). While this flood planning level may be appropriate for other floodplains, it does not adequately take into account regional flood risk in the valley. This is because flood levels can be up to nine metres above the flood planning level at Windsor.

Since a Ministerial Direction issued in 2007, councils have only been able to apply flood related development controls for residential development for flood events rarer than the 1 in 100 chance per year flood if they applied for and were granted exceptional circumstances.

An action under Flood Strategy **Outcome 3** is to review the policy arrangements and land use planning guidance relating to flood behaviour above the 1 in 100 chance per year flood level in the valley. This review will be consistent with the principles of the Western City District Plan and Central City District Plan, which both include consideration of the full range of flood risk. This is consistent with the Floodplain Development Manual (2005) and the Australian Disaster Resilience Handbook 7: Managing the floodplain: best practice in flood risk management in Australia. This review will inform the Regional Land Use Planning Framework.

5.2 Regional Land Use Planning Framework

Flood Strategy **Outcome 3** requires the development of a Regional Land Use Planning Framework (framework), led by Department of Planning, Industry and Environment. This framework will encompass an approach that better considers flood risk and carefully manages population growth in the valley. It will help improve the resilience of the communities within the valley to floods, including managing the cumulative impact of growth on road evacuation capacity and risk to life.

The framework will consider the different characteristics and relationships to the floodplain from each council. It will identify a land use pattern that considers the different flood risks and characteristics across the valley and will seek input from councils and key stakeholders.

The development of the framework will be drawn from three key elements, these are:

- flood behaviour - how the flood waters move through the catchment, as well as the depth and velocity
- the population at risk - utilising the latest housing forecast data from the Department of Planning, Industry and Environment and future dwelling forecasts from councils, and
- risk to life - the ability for the existing population to safely evacuate from the valley to areas outside the floodplain.

The framework will provide the basis for decisions to be taken in consideration of the vulnerability of certain locations in the valley to further development. It may be necessary to consider whether the development allowable under the current land use planning provisions needs to be restricted to ensure there is evacuation capacity to match the development potential. This may involve changing existing zonings and land use planning policies.

The Department is currently also progressing a number of projects that will contribute to the development of the framework, these include the flood resilient building controls project and the of review of existing land use planning guidance relating to flood. These projects are outlined below.

5.2.1 Flood resilient building controls project

This project is investigating where flood resilient building controls should apply within the valley based on cost / benefit. The project will develop flood resilient building controls for residential development to ensure a more resilient community during extreme floods.

5.2.2 Review of existing land use planning guidance relating to floods

This project is reviewing the Ministerial Direction - Flood Prone Land, Planning Circular PS 07-003 and the Guideline for Residential Development on Low Flood Risk Land. This revised approach to considering the flood risk in land use planning will enable councils to apply development controls on residential uses for events above the 1 in 100 chance per year flood, where appropriate. This is consistent with the Floodplain Development Manual (2005) and the Australian Disaster Resilience Handbook 7: Managing the floodplain: best practice in flood risk management in Australia. This project is discussed further below.

5.3 Consideration of flood risk in current land use planning decisions

In the case of new developments, land use planning decisions are being made based on the cumulative impact of growth on evacuation capacity in the valley. In the past five years, the Department of Planning, Industry and Environment has refused proposals for rezoning within the floodplain due to the lack of evacuation capacity. This included not rezoning the proposed 5,000 dwelling residential development in Penrith Lakes, a planning proposal for increased residential development in Windsor, and the Emu Plains Corrections facility, which NSW Corrections decided not to proceed with once the flood risks were modelled and understood.

The North West Growth Centre Structure Plan was released in 2006. The approach to development in the North-West Growth Centre has changed due to the flood risk.

Recently exhibited land releases (Marsden Park North and West Schofields) include flood provisions to cap the development to ensure all new residents can evacuate safety. Higher density development in these land releases is only allowed in areas outside the extent of the probable maximum flood as these areas do not require to be evacuated. The draft masterplans for Marsden Park North and West Schofields ensure that new houses will not be located in high risk flood areas and that evacuation routes allow residents to leave the area safely in the event of severe to extreme flooding.

6 Other Flood Strategy Outcomes

The Flood Strategy is currently in its first implementation phase.

While there has been much focus on the Warragamba Dam Raising proposal, implementation of other important elements of the Flood Strategy is well under way. This implementation is focused on shorter-term actions to improve resilience to floods. These actions include improving land use planning arrangements to account for flood risk (**Section 5**), improving capacity to respond to flood emergencies, improving flood mapping, forecasting and warning, and improving flood awareness and resilience of the community.

6.1 Monitoring, forecasting and warning actions

To safely evacuate people in a flood emergency, the NSW State Emergency Service relies on forecasting and flood predictions from the Bureau of Meteorology.

Under the Flood Strategy, over $2 million has been allocated to the Bureau of Meteorology to enhance their flood forecasting capability for the Hawkesbury-Nepean Valley.

Improved rainfall and flood forecasts, new modelling, flood guidance, and decision-making tools for the NSW State Emergency Service will provide greater clarity about the timing, behaviour and heights of floods. This will support improved emergency response. The project is well progressed, with trialling the new forecasting tools completed in mid-2019 and training for users scheduled for late September 2019.

6.2 Emergency response and recovery planning

NSW government agencies, including Transport for NSW, Infrastructure NSW and the NSW State Emergency Service are working together to improve evacuation planning and response.

The evacuation plan for the Hawkesbury-Nepean Valley is included in the Hawkesbury-Nepean Flood Plan[10], a state-level emergency plan in recognition of the significant flood risk in this valley. It has been revised and updated to reflect the ongoing emergency planning work over the last five years.

A specific Hawkesbury-Nepean Valley Flood Recovery Plan has been developed in recognition of the long term social and economic consequences of recovery associated with the significant flood risk in this valley.

In mid-2019, the emergency services sector undertook a series of cross-agency exercises and workshops, known as Exercise Deerubbin, which tested emergency preparedness, response and recovery in relation to a major flood in the Hawkesbury-Nepean Valley. Included in this was the first testing of the activation of Qudos Bank Arena in Sydney Olympic Park as a mass care facility for evacuees, involving hundreds of volunteers and emergency services personnel.

A key element of the Flood Strategy is a $1.8 million signage project to help guide people along evacuation routes and out of the floodplain which was rolled out in December 2018. The signage system was developed for use along the current Hawkesbury-Nepean Valley flood evacuation routes. The new signage will help people safely navigate out of the floodplain during an evacuation. The design of the system was informed by extensive user testing through driver simulations, technical field surveys and surveys of floodplain residents.

[10] https://www.ses.nsw.gov.au/media/1627/plan-hawkesbury-nepean-flood-plan-sept-2015-endorsed.pdf

6.3 Better flood risk information

A Regional Flood Study has been prepared for the Hawkesbury-Nepean Valley.[11] The flood study updates the modelled flood risk from the Hawkesbury-Nepean River across the region, and helps plan for and manage flood risk. The study covers riverine flooding, it does not cover overland flow or tributary flood risk which are usually covered in local flood studies (done by councils).

The last regional flood studies for the valley were completed more than 20 years ago. Since then, there have been significant advances in the science of flood modelling, increased understanding about the impacts of climate change, infrastructure changes, and significant population growth and development within the valley.

The Regional Flood Study provides guidance for significant planning and development considerations at regional level. It will inform the Flood Strategy programs of work. It will also provide regional flood information for local councils, residents and businesses, and be available to be used by insurance companies to help inform insurance premiums.

As a companion piece to the Regional Flood Study, an asset database has been developed and updated with the latest information to map and assess all development in the floodplain, both now and in the future.

6.4 Increasing community flood risk awareness and preparedness

The community has an important role to play in getting ready for flood.

The risk to life in a flood emergency increases if people aren't aware of, or understand their flood risk, delay or refuse to evacuate, drive through floodwaters, or drive back into flooded areas after an evacuation order has been given.

Evacuation when directed by the emergency services is essential to protect lives in the Hawkesbury-Nepean Valley. Flood-ready households are also more likely to raise or relocate movable items, invest in flood-compatible building materials, and take out flood insurance.

The Flood Strategy includes a broad range of actions across government and the community to build resilience to floods.

A recent survey of floodplain residents found that only 18% were aware that they lived in a high-risk area for flooding. Around 80% had done nothing to prepare for floods.

As part of raising flood risk awareness, contemporary flood risk information is essential. New mapping based on the Regional Flood Study, along with information on how to prepare for floods, was made available to the community as part of the release of the new Regional Flood Study in July 2019.

Other initiatives under way include:

- a new curriculum support resource – Flooding in the Hawkesbury-Nepean Valley - being developed for high school Geography teachers and students across New South Wales using flooding in the Hawkesbury-Nepean as a case study,
- a school emergency planning project aimed at boosting the awareness and preparedness of schools at risk of flooding across the floodplain,

[11] http://www.infrastructure.nsw.gov.au/expert-advice/hawkesbury-nepean-flood-risk-management-strategy/

- increasing flood preparedness with targeted programs for the most vulnerable floodplain communities, such as the aged, people with a disability, social housing tenants, livestock and animal owners, and families with young children, and
- a broad community campaign on flooding to boost awareness across local communities using contemporary information and platforms under the Government's new 'Get Ready' for flood Hawkesbury-Nepean campaign planned for September to November 2019.

7 Implementation of Recommendations of Inquiry into the W*ater NSW Amendment (Warragamba Dam) Bill 2018*

The Government has provided a response to the recommendations of the inquiry into the *Water NSW Amendment (Warragamba Dam) Bill 2018* by the Standing Committee on State Development in October 2018.

One recommendation from the Standing Committee was to include within the amendment a requirement to exhibit the Environment Management Plan for 45 days for the operation of a raised Warragamba Dam for flood mitigation. While this amendment did not pass, it has been agreed by the Minister administering the *National Parks and Wildlife Act 1974* and the Minister administering the *Water NSW Act 2014* that the Environmental Management Plan (under Part 5A of the *Water NSW Act 2014*) would be put on public exhibition for 45 days.

Two recommendations from the Standing Committee were about Legislative Council procedures and were referred to the Legislative Council for consideration.

All other recommendations were supported.