NSW GOVERNMENT

Select Committee on the Proposal to Raise the Warragamba Dam Wall, 25 November 2019 (Uncorrected Transcript)

Questions on Notice

1. Projected population increase

Question

What is the projected population increase in the floodplain area over the next 10 to 20 years?

Answer

The Hawkesbury-Nepean floodplain is defined as the area up to the probable maximum flood (PMF) between Bents Basins and Brooklyn Bridge, covering around 425 square kilometres. The floodplain falls mainly within four local government areas – Blacktown, Hawkesbury, Penrith and The Hills.

The Department of Planning, Industry and Environment is unable to provide the increase in population within the floodplain as the Department's population projections are at a local government area (LGA) scale. The Department's method of population projection aggregates the smallest geographic area where projections are made to the local government area. Population projections are reported at local government scale.

Below are the projected population figures for the four key floodplain LGAs from 2016 until 2036.

LGA	2016	2021	2026	2031	2036	Total increase between 2016-2036
Blacktown	312,350	349,050	387,200	433,500	475,800	**172,400**
Hawkesbury	64,350	67,800	71,000	74,800	79,400	**17,250**
Penrith	184,600	205,150	221,600	237,500	253,600	**65,600**
The Hills	147,950	165,550	187,650	225,150	256,900	**125,350**

***Note**: These data are per LGA. They include populations located outside of the Hawkesbury-Nepean floodplain. They are not reflective of the population residing within the floodplain.*

2. Number of dwellings built on the floodplain

Question

Number of dwellings built on the floodplain from 2011/12 until 2018/19?

Answer

These data represent dwellings constructed or near completion on properties within the extent of the Probable Maximum Flood (PMF). The Hawkesbury-Nepean floodplain area up to the PMF covers 425 square kilometres. The four most affected local government areas are Hawkesbury, Blacktown, Penrith and The Hills.

Dwellings numbers by year	Up to 1:500 chance per year flood or 0.2% annual exceedance probability	Up to 1:1000 chance per year flood or 0.1% annual exceedance probability	Up to Probable Maximum Flood (PMF)
2011	**10, 100**	**13,100**	**25,700**
2011 – 2018 increase	**3,600**	**4,600**	**9,100**
Total (as at December 2018)	**13,700**	**17,700**	**34,800**

Note: The dwelling figures above are derived from Infrastructure NSW data, sourced primarily from Spatial Services (2018 aerial photography and address points as of March 2018), the Department of Planning, Industry and Environment, and floodplain councils.

The dwelling numbers above **include** residential properties, including multi-unit dwellings, non-private residences such as nursing homes and retirement homes. The numbers **exclude** dwellings that have DA approval but for which construction has not commenced (as of Dec 2019) as well as manufactured homes and permanent caravans being used as permanent dwellings. Around 50% of the dwellings in the floodplain completed since 2011 (4,600 of the total increase of 9,100) have occurred above the 1 in 1000 chance per year flood level.

3. Annual average damages

Question 1

Does the 75 per cent reduction in annual average damages from flooding with the dam raising relate to the current development in the Valley, or future development?

Answer 1

Economic assessment consultants to the Hawkesbury-Nepean Valley Flood Management Taskforce calculated the reduction in the annual average damages for the 14-metre raising of Warragamba Dam to be 76 per cent in 2015, and 75 per cent in 2041.

Question 2

What is the 75 per cent a reduction of?

Answer 2

The ongoing impact of infrequent but catastrophic events is calculated by adding up the chance of the events by their impact. Floods are random and have different chances or probabilities of occurring in any given year. The standard method used by flood risk managers, emergency planners and actuaries/ flood insurers is an average annual damages assessment (or AAD).

The annual average damage is a long-term average, and is assessed for the full range of representative flood events with probabilities of 1 in 5 chance per year up to a probable maximum flood (PMF).

As a simplified example, say a town was subject to three flood events with estimated damages:

- a 1 in 50 or 2% chance per year event with estimated damages of $5M
- a 1 in 100 or 1% chance per year event with estimated damages of $20M
- a 1 in 200 or 0.5% chance per year event with estimated damages of $50M

The annual average damage is calculated by multiplying the probability of the flood event with the estimated costs. A simplified calculation of the annual average damages for the above example would be:

(2% × $5M) + (1% × $20M) + (0.5% × $50M) = $0.1M + $0.2M + $0.25M = $0.55M per year.

Therefore, the average annual damages for the town would be quoted as $0.55M per year, which means that the town could expect $0.55 million of flood damages on average every year.

In practice, 'Simpson's Rule' would be applied to accurately calculate the area under the damage curve. This means that the average annual damage would be slighter higher than the simple example above.

Annual average damages assessments are important for relative comparisons of different mitigation options with the existing average annual damages. This is the standard method for determining the benefits of a benefit:cost ratio.

Annual average damages (cont'd)

Question 3

Given there is significant uncertainty, depending on where the waters fall in the catchment, and about how much the dam wall raising will change the flood heights at different locations, how can you arrive at any meaningful average figure of reduce costs?

Answer 3

The standard method used by flood risk managers, emergency planners and actuaries/ flood insurers is an average annual damages assessment (or AAD).

As extreme flood events are infrequent, hydrologists apply the techniques outlined in Australian Rainfall and Runoff Guideline (2019) to model infrequent and extreme flood events from the historical flood and rainfall records.

Usually only the representative flood events are generated, such as the 1 in 50 year, 1 in 100 year, etc. However, the Hawkesbury-Nepean Valley Flood Management Taskforce took advantage of improved computing power to generate nearly 20,000 flood events with the full range of potential rainfall events and catchment conditions over different areas of the catchment at different timing. This 'Monte Carlo' approach ensured that the modelled flood events represent the variability observed in real floods, with varying rates of rise and extent of flooding. This modelling was undertaken by experts and subject to independent peer review.

The representative flood levels for the calculation of the average annual damages were determined by sorting and ranking the suite of Monte Carlo events. As a result, the calculated flood levels and associated average annual damages for this floodplain include the full variability of flood events.

4. Timing benefits of raised dam

Question

What is the best and worst case delay in the flood at different points in the river, including at Wallacia and Penrith?

Answer

With a raised dam, the best case would be that the flood no longer reaches critical levels. For those events that still reach critical levels, there would be significant delay in the flood peak.

Windsor

For example, with a 14-metre dam raising, 83% of the modelled flood events reaching 17.3 metres at Windsor (the flood planning level and the level of the road on Jim Anderson Bridge) would no longer reach that level. For the remaining 17% of modelled flood events that would still reach this level, 12% would be delayed by over 10 hours, 3% would be delayed between 5 and 10 hours, and 2% would be delayed by less than 5 hours.

The worst case for Windsor would be that there is no delay in reaching this flood level. However, this would be in an extremely rare event with a probability of 1 in 100,000 chance per year - similar to the likelihood of the probable maximum flood – PMF. Nevertheless, the peak of this flood would still be reduced.

The results would be similar for Richmond.

Penrith

With a 14-metre dam raising, 83% of the modelled flood events reaching 25.7 metres at Penrith (1 in 100 chance per year flood) would no longer reach this level. For the remaining 17% of modelled flood events that would still reach this level with a raised dam, 14% would be delayed by over 10 hours, 3% would be delayed between 5 and 10 hours, and no floods would be delayed by less than 5 hours, ie, the worst case is 5 hours delay.

Wallacia

Wallacia is upstream of the confluence of the Warragamba and Nepean rivers. The interaction between the flow of these two rivers during flood events is complex, with backwater effects impacting flood risk at Wallacia. The modelling to date indicates Warragamba Dam raising would reduce flood levels significantly, with most modelled events greater than a 1 in 100 chance per flood lowered by 3 metres, and delayed up to 10 hours. However, more detailed hydraulic modelling is being commissioned to better understand the complex dynamics of flooding in the Wallacia area.

5. Reduction in flood levels with the dam raising appears to be the best case

Question

Is the reduction in peak flood levels with the raised dam the best case?

Answer

No.

In 'Monte Carlo' flood modelling, the flood level is determined by ranking the modelled flood events to reveal the level of the flood of that frequency. For example, the 20,000 Monte Carlo modelled flood events for the Hawkesbury-Nepean represent the floods that could occur in 200,000 years (under static climate conditions).

When the 20,000 modelled flood peaks at a particular point are sorted from the highest to smallest, the 2,000th largest event being the 2,000th out of 200,000 possible annual flood peaks is the 2,000/200,000, or a 1 in 100 chance per year flood level at that point. The reduction in peak levels is made by comparing the ranking of the flood levels of the 20,000 Monte Carlo flood events with and without the dam raising. This is the most likely reduction in peak levels.

The reduction in the flood peak with the dam raising varies for the individual 20,000 Monte Carlo flood events. For example, floods reaching the current 1 in 100 chance per year flood level a Windsor (17.3 m AHD, Australian Height Datum) would be reduced from 2 to 6 metres depending on the rainfall pattern, catchment conditions, and resulting flood inflow origin, timing and magnitude. That is, the best case would be a reduction of 6 metres, and the worst case a reduction of 2 metres. The 4.1 metre reduction quoted would be similar to a median value of flood peak reduction at Windsor.