

From:
To: [Flood Inquiry](#)
Subject: Flood Inquiry Submission from a retired flood engineer re need for evacuation
Date: Monday, 25 April 2022 11:22:10 PM

THE NEED FOR BETTER COMMUNITY KNOWLEDGE OF "RARE" FLOODS TO ENCOURAGE EVACUATION

In 1990, I was employed by the Public Works Department as a flood engineer and worked there, or under its subsequent departmental banners, before retiring in 2009. In the early 1990s, I was part of a small team assisting councils with flooding issues in the Northern Rivers area including Lismore but also Murwillumbah, Grafton, Ballina, Byron Bay, etc. I was also involved in reviewing the horrendous Wollongong flash floods of 1998 and, in later years, assisting our Department in developing a planning strategy for the Hawkesbury-Nepean River in association with other government authorities including the SES, Dept of Planning, DoCS, RTA, councils, etc.

I would like to address the risk to life of those trapped within residences and other buildings. Sadly the tragic loss of life in Lismore in this manner highlights what I believe is insufficient communication of the flood risk to occupiers and the need for early evacuation.

The old adage "*if you live ON a floodplain, you're living IN the river*" is seldom more apt than in Lismore with around 90 floods above 6 metres since 1870 and some 30 floods in 30 years after WW2. The Lismore flood of Feb/Mar 2022 was tragically unusual as several lives were lost when people were trapped in houses.

Assuming the design flood levels in Table 4.5 of the Draft Lismore Floodplain Risk Management Study (October 2020) are correct, then the design levels at the Rowing Club are:

PMF	16.55 m AHD (Probable Maximum Flood)
500 year	13.02 m AHD
100 year	12.47 m AHD

With the recorded peak of the Feb/Mar 2022 flood being around 14.5 m AHD, it was about 1.5 m above the 500 year design level and about 2 m above the 100 year traditional minimum floor level i.e. effectively totally flooding a house with a floor at this level. Based on these levels, this is very likely the rarest recorded flood in Australia and I'm sure this Inquiry will estimate the design flood level of this event.

My recollection is that even well into this event, rainfall and flood level predictions were very much underestimated. Others will need to address that matter but what this flood has shown is that floods are fickle and that rare floods are possible and not always predictable. With over 3,000 residents being impacted by this flood (based on Table 5.10 of the Management Study) this demonstrates the imperative that people evacuate early in floods in towns like Lismore where the range of flooding is significant.

I fully appreciate and understand the emotion in the community but I was disappointed that some seemed to blame the SES management and other authorities for not acting rapidly whereas early self-evacuation would have saved all lives and eliminated the need for dangerous rescues from houses, roofs, etc. While unnecessary evacuations can lead to community complacency and the "boy who cried wolf" concern, it is perhaps the lesser of two evils given the extreme trauma suffered in this flood.

I know 1974 flood markers have been installed on poles in the town but at around 12.1 m this was slightly below a 100 year flood and can provide a false sense of security especially for those in houses with floor levels above this who may feel they are safe. I believe it is very important for residents, occupiers, owners, etc to be aware of the full range of flooding and just how probable they are despite often being referred to as rare. This is where I'd like to make my contribution.

Rare floods are not that rare when the period of occupancy is considered

A 100 year (or 1%) flood has a 1% probability of being equalled or exceeded in any given year. Similarly for a 500 year (or 0.2%) flood.

But this is in *any given year* and when the period of occupancy on the floodplain is taken into account, these "rare" events become much more probable over time.

For example, with 30 years of occupancy, the probability of experiencing a 1% event is around 26%. Similarly, over a 70 year period (roughly a lifetime) the probability of experiencing a 500 year (or 0.2%) flood is around 13%. Thus it can be seen that "rare" floods are not so rare when the occupancy period is taken into account. With respect to Lismore, in its roughly 177 years since European settlement, there is a greater than 16% probability of a 1,000 year flood.

Towards the end of my career, I began promoting these "occupancy" probabilities which I hadn't ever seen presented in studies, reports, etc. I felt it was important to demonstrate that rare floods are not as rare as some may think and, especially where the range of flooding can be a serious risk to life, this should be considered in planning. Community knowledge of this is also an incentive to encourage early evacuation. It is possible that councils, residents, property owners, etc may not appreciate having the flood dangers advertised but that may be the trade-off for safety for occupiers and rescuers.

Here is a table of occupancy probabilities:

AEP	ARI yrs	Occupancy period in years						
		100	70	50	30	20	10	1
10%	10	100.00	99.94	99.48	95.76	87.84	65.13	10
5%	20	99.41	97.24	92.31	78.54	64.15	40.13	5
2%	50	86.74	75.69	63.58	45.45	33.24	18.29	2
1%	100	63.40	50.52	39.50	26.03	18.21	9.56	1
0.50%	200	39.42	29.59	22.17	13.96	9.54	4.89	0.5
0.20%	500	18.14	13.08	9.53	5.83	3.92	1.98	0.2
0.10%	1000	9.52	6.76	4.88	2.96	1.98	1.00	0.1

If interested, the formula is **Probability (%) = 100 x {1 - [1 - (1/Event)]^OP}** where Event is the flood of interest e.g. 100 (year flood), OP is the Occupancy Period in years and ^ represents "to the power of".

In Lismore, because it is already very developed, there is little opportunity to apply this to planning so encouraging early evacuation is the main intention. However, in currently undeveloped floodplains this could be applied to planning. For example, on the Hawkesbury River floodplain around Windsor, the PMF level is around 9 m above the 100 year flood level or around the height of a three storey house.

If one believes that climate change will bring more severe, frequent and unpredicted floods, then planners should consider the occupancy probabilities to ensure occupiers are

evacuated in a timely manner.

With respect to future planning and flood resistant building, your attention is drawn to the set of three award-winning guidelines produced around 2006 as part of the Hawkesbury-Nepean Floodplain Management Strategy - Land Use, Subdivision and Building. These guidelines have been uploaded to the SES FloodSafe website (link below). I recall that hard copies were sent to all NSW councils. Whilst these were produced for the Hawkesbury-Nepean floodplain, each are generally applicable to all floodplains.

<https://www.ses.nsw.gov.au/local-region-information/swr/hawkesbury-nepean-floodsafe/>

CONCLUSIONS

Especially in flood prone towns with a large flood range, I believe property owners, residents, occupiers, etc should be much better informed of the full flood range and that rare floods are not so rare when the occupancy period is considered. I feel that this knowledge, frequently reinforced, will encourage early evacuation and therefore prevent deaths in buildings and hopefully eliminate the need for dangerous rescues.

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