Our reference: ECM 9750007
Contact: Peter Wood
Telephone: (02) 4732 7577

15 December 2021

Department of Planning, Industry and Environment

Attention: David Way

Email: david.way@planning.nsw.gov.au

Dear Mr Way,

Submission in Response to the Exhibition of the Environmental Impact Statement (EIS) for the Proposed Raising of Warragamba Dam (State Significant Infrastructure Development Application No. SSI-8441)

I refer to the exhibition of this State Significant Infrastructure Development Application. Thank you for providing Council with the opportunity to review the proposal and make a submission.

The attached submission focuses on the following environmental implications and matters for further consideration:

- The EIS shows that the Dam raising impacts evacuation in a positive way. The most positive impact for evacuation that is observable is the increase of time gained before bridges and roads close in evacuation routes. The attenuation of water by the Flood Mitigation Zone (FMZ) has positive affectation on flood extents in the floodplains with large reduction in flood extents downstream of Penrith LGA, particularly in the Richmond and Windsor areas through many of the design storm events. There are several arterial evacuation routes from the Richmond and Windsor sectors that funnel evacuees south through the Penrith LGA, a reduction in flood extents will reduce the number of residents utilising the routes and therefore reduce congestion during this time. This has a compounding positive effect to flood evacuation with the increase of time allowed before roads and bridges are cut off.

  However, further information is required for a better understanding of the impacts of the dam raising including:

  - Flood modelling data to support positive impacts
  - the 1% AEP Change in Peak Flood Extent Map
  - Data showing the reduction of people requiring evacuation with dam raising
  - Data related to road and bridge cut of areas during prolongation of low-level flooding due to FMZ
  - Explanation for reduction in time to cut off at Cattai Creek Road Bridge
  - Differences to low and high flood islands identified in report when dam is raised
  - Inclusion of the Penrith CBD Floodplain Risk Management Study and Plan 2020

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

- The proposal will have considerable impacts on the environment, including World Heritage Values, notably biodiversity values and Aboriginal cultural heritage which on biodiversity grounds in isolation, suggests the proposal should not be supported. The project will result in irreversible and uncertain impacts for biodiversity which have not been adequately addressed in the EIS. It is essential that an independent review of the EIS by relevant species and ecological experts is undertaken to ascertain whether the assessment is in accordance with relevant survey guidelines for particular species and the impacts accurately considered.

- The EIS has not adequately addressed potential impacts on water quality and the geomorphology of riparian corridors resulting from the increase in periods of inundation of the upstream catchment nor the duration of sustained flows through the river channel resulting from emptying of the Flood Mitigation Zone;

- The proposal introduces significant vehicle trip generation on roads within Penrith LGA during construction. The resulting the impacts need to be more satisfactorily addressed in terms of amenity and ensuring that the condition of roads and related assets has not deteriorated post development.

Based on our review of the EIS, the application has not adequately demonstrated that the potential impacts of the proposal are satisfactory in relation to the above matters. It is therefore submitted that the current application should not be supported based on the exhibited EIS.

Should you wish to discuss any aspect of Council's comments further, please contact me on (02) 4732 7577.

Yours sincerely

Peter Wood
Development Services Manager

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

15 December 2021

Annexure 1

Submission in Response to the Exhibition of the Environmental Impact Statement for the Proposed Raising of Warragamba Dam (State Significant Infrastructure Development Application No. SSI-8441)

1. Planning Considerations

As the proposal is aimed at improving existing flood evacuation opportunities within the Penrith LGA, the statutory planning context including DPIEs recent mandating of additional LEP flood provisions must be reconsidered with regard to:

- A policy/strategy of how the new flood risk is to be incorporated post the dam upgrade.
- How does Council update its flood studies and floodplain risk management plans?
    - Council will need to review and update all its relevant flood studies and floodplain risk management plans. Funding from State Government would be required to review and update its studies.
    - Flood models and data from State Government would be required to update Council's studies.
- The EIS states that the flood mitigation capacity of the dam would decrease with time due to climate change (Chapter 5, Pg5-1). If Council revises the flood risk management plans based on the current flood mitigation capacity of the raised dam, those FRMPs would need a constant revision to ensure that the reduced mitigation capacity is considered.
- SEARs require mapping of Flood Planning Area (Chapter 15, page 15-3) for the new design flood under the Project. This has not been provided.
- A statutory requirement that the downstream floodplain development is not intensified to make use of the reduced flood risk due to Warragamba Dam Raising. This is important because climate change would reduce the dam's risk mitigation capacity and the risk of dam failure would increase, which would require a higher standard of dam maintenance.
- How the revised risk of modified dam is to be conveyed to the community.
- Does Council need to start updating the flood study well before the wall raising project is completed, so that a new flood study is ready and the new flood planning areas are established and ready to be utilised for development planning and controls.
- Statutory requirement to impose restriction on use of Flood Mitigation Zone of the dam for water supply or any other purposes.

These aspects may impose a significant resourcing and cost burden on Council's.

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

2. Development Engineering and Flood Management Considerations

Council's full report on development Engineering and Flood Management Considerations forms an attachment to this submission.

3. Biodiversity Conservation Considerations

While there are a number of positive implications of the proposed works on flood planning and evacuation capability for the Penrith LGA, there are also equally a significant number of critical environmental concerns identified as a consequence of the proposed works that require careful consideration and address in the assessment of the application. These are outlined below:

- The EIS states that the cost-benefited analysis demonstrated that the proposed raising of Warragamba Dam will provide a 75% reduction in flood damages on average and reduce current levels of flood damage from $5 billion to $2 billion (2016 dollars). The documentation provided however does not discuss alternative measures that have been explored that would better mitigate the impact of downstream flood impacts as alternative options. This aspect should be better addressed and demonstrate why / how this proposal was deemed to be the most appropriate on balance.

- Development of the methodology relied upon allegedly involved consultation with the former Office of Environment and Heritage (OEH, now the Environment, Energy and Science (EES) Group within the Department of Planning, Industry and Environment, DPIE), particularly on application of the FBA for the Project. The upstream study area comprises the area between full supply level (FSL) and the Project PMF. This equates to an area of about 5,280 ha. The principal areas of interest in the study area for the assessment are the survey area and upstream impact area. For the Framework for Biodiversity Assessment (FBA) and calculation of offset requirements for the upstream impact area, a precautionary approach was allegedly adopted; this assumed a 100 percent loss of vegetation/habitat within the area between the likely inundation level with the Project (10.25 m above FSL, RL 126.97 mAHD) and the likely inundation level for the existing dam (2.78 m above FSL, RL 119.5 mAHD). The size of this area is about 1,400 ha. The field study area was identified as the area within a representative 1 in 100 chance in a year event (1% AEP) with the Project plus nine percent climate change (that is, a nine percent increase in rainfall under a climate change scenario). This equates to an area of about 3,740 ha.

- The EIS has stated that the 1 in 10 chance in a year flood event would have the greatest difference in inundation extent between the existing and Project flood scenarios. It was allegedly agreed that the 1 in 10 chance in a year flood inundation extent would represent the area for the downstream assessment. It was also agreed that survey and assessment within the downstream operational area of the Project would be truncated at the confluence of the Hawkesbury and Colo Rivers. The assessment focuses on potential impacts associated with the survey area (1 in 10 chance in a year flood) and the increased duration of temporary inundation resulting from emptying of the Flood Mitigation Zone (FMZ). A total of 1,370.24 ha of native vegetation has been mapped within the upstream impact area.

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

- It is outlined that the Project would impact 430.56 ha of White Box Yellow Box Blakely's Red Gum Woodland CEEC within the upstream impact area. The EIS concludes the Project may impact on a CEEC as a result of potential impacts to: White Box Yellow Box Blakely's Red Gum Woodland CEEC but that these impacts are unlikely to cause the extinction of the CEEC from the IBRA subregion or significantly reduce the viability of the CEEC. This entity is already at risk of extinction and it is considered that the project would result in a considerable impact to this community. This aspect requires detailed consideration and further address and explanation from the applicant.

- It is also understood that the project will impact on 107.09 ha of River-flat Eucalypt Forest which is listed as an endangered ecological community under the BC Act and critically endangered under the EPBC Act. This is also of particular concern.

- The EIS identifies 76 threatened flora species may be 'adversely impacted' and 16 threatened fauna species may be impacted. It is noted that surveys did not survey the entire impact area and it is possible that other populations or other species are present within the footprint. The EIS has stated that temporary inundation may modify habitat for threatened flora species by altering soil properties such as structure and chemistry or causing erosion in turn affecting plant survivability, growth, germination and/or recruitment. If loss of individuals is experienced, this is likely to contribute to fragmentation and isolation of local populations which represents a significant biodiversity concern.

- The EIS has concluded that the project poses potential significant impacts to breeding habitat for the critically endangered species of the Regent Honeyeater that cannot be avoided or minimized. The assessment has concluded in Table 8-33 that a large breeding population of Regent Honeyeaters were recorded around Tonalli Cove. Impacts from temporary inundation may include loss of structural components of the vegetation (for example, *Amyema pendula* and *Amyema cambagei*) within areas of suitable breeding habitat, mortality of nestlings should a flood occur during a breeding event, and potential loss of suitable foraging habitat, specifically feed tree species such as *Eucalyptus melliodora*, *Eucalyptus albens*, and *Eucalyptus eugenioides*. A total of 1,264.55 ha of habitat for this species will be impacted. The local population potentially impacted by the Project comprises a minimum of 21-35 individuals. This includes the number of adult and juvenile birds detected during targeted Regent Honeyeater surveys conducted in November 2017 (21), and the number of nestlings observed at two nests at the time of surveys (4), assuming each fledged successfully. This figure represents 5-7 % of the estimated population of the Regent Honeyeater (DoE, 2016) (Kvistad et al. 2015) and this breeding population represents one of less than five known remaining breeding populations that are known to support at least 20 individuals (DoE, 2016) (Crates et al. 2018). It is believed that there are less than 350 individuals left in the world (pers. Comm Dr. Ross Crates 2021). The loss of a population between 21-35 individuals does not represent 5-7% of the estimate population but is actually more like 6-10% which must be noted and addressed in the assessment.

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

- The EIS has discussed different experiments including *Eucalyptus benthamii* inundation experiment prepared by CSIRO dated 24 April 2019. These experiments are not relevant to the current proposal as:

    - The experiment was limited with only inundating the trees at a depth of 30cm and is not comparable to the depth the downstream banks would receive of 2.5m.
    - The experiment was undertaken in Deniliquin in different soil characteristic and climatic conditions than what would occurs in the proposed impact area.
    - This experiment did not test impacts of inundation of other species associated with the vegetation communities that would be affected.

    The EIS also recognizes that there are some key differences between the scenario within which the experiment was carried out and the modelled conditions expected to occur within the Kedumba River population of *E. benthamii*. Specifically, the depth of inundation as a result of the project is likely to be higher and the extent of duration lower than the experimental situation

- The construction of the Project would require the clearing of 1.64 ha of critically endangered Shale Sandstone Transition Forest. This occurrence of SSTF is on the edge of its community's range and therefore has the potential to significantly reduce the viability of the CEEC in the subregion. It will also result in the removal of 20.78 ha of native vegetation and impact on 1 known threatened flora species (Grevillea parviflora subsp. parviflora and an additional 7 potential threatened flora (assumed present) and 15 threatened fauna species. This represents a significant biodiversity concern.

- According to the Ecological Assessment, the downstream impact assessment focuses on potential impacts associated with the survey area (1 in 10 chance in a year flood) and the increased duration of temporary inundation resulting from emptying of the FMZ. This was because it was predicted that the 1 in 10 chance in a year event would likely have the greatest change in extent due to differences between the existing and with the Project flood extent scenarios. These events have been modelled using the best available information, however there remains a level of uncertainty on the frequency and extent of these flooding scenarios. Furthermore, the potential impacts on biodiversity will vary depending on the frequency, duration and extent of flooding experienced following the implementation of the Project and other stresses in the landscape. This requires further address and analysis in the assessment of the application.

- The document states that the project will: *increase flood durations within the FMZ discharge area, ranging from an additional five days for a 1 in 5 chance in a year event, up to eight days for a 1 in 100 chance in a year event.* The impacts downstream have been identified as having a:

    - Reduced frequency of peak outflow occurrence from 1 in 100 chance in a year to about 1 in 1500 chance in a year with the Project.
    - Reduction in peak flow changes from 9,660 m3/s to 3,800 m3/s.
    - Reduction of about 1,180 ha of native vegetation in the catchment previously affected in this event.

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

- Increased duration of inundation in FMZ discharge area of about 11 days instead of 4 days (that is an increase of 7 days).
- Increased inundation duration of up to 1,926 ha of wetland and floodplain habitats in the FMZ discharge area.

- A total of 4,435.8 ha of native vegetation within the downstream survey area was mapped. Potential biodiversity impacts are principally related to:

  - *Reduction in flood frequency and extents resulting in reduced water availability to plants and wetland replenishment. As previously noted, the Project would have no impact on local flooding and any flood dependent vegetation would be largely dependent on local catchment flows, rather than overbank flooding from the Hawkesbury-Nepean River.*

  - *Increase in flood durations within the FMZ discharge area. Once peak flood levels in the downstream river have decreased, the discharge of water from the FMZ would commence. Apart from some piggy-back discharges (or short duration higher discharges) for the first few days after a large flood event, the rate of discharge from the FMZ would be constant at around 100 gigalitres per day. There would be minimal overbank flows, however low level or backwater flooding would remain in some areas, such as the Penrith lakes area, due to the inability of tributaries to drain due to high main river water levels. This low-level flooding would persist for five to eight days longer than an existing flood event. Vegetation in these areas that is not tolerant of additional inundation may be adversely impacted.*

  The report has not adequately examined whether the vegetation in these affected areas are 'tolerant' of the increased time of inundation which must be addressed.

- The EIS also identifies that the following impacts could occur:

  - changes to wetland and floodplain vegetation communities and habitats
  - changes to terrestrial woodland and forest communities and habitat
  - bank erosion and slumping resulting in vegetation community and threatened species habitat degradation
  - increased fine sediment deposits reducing water quality
  - displacement of fauna habitat resources
  - displacement of habitat for fauna dependent on riparian or wetland habitats
  - spread of exotic species
  - spread of disease and pathogens

  The risk assessment created to work out whether assessments are required for biodiversity matters is not scientific or robust and is recommended to require further address.

- The statement as to why the Risk for biodiversity was categorized as "Minor" for 'Bank erosion and slumping resulting in vegetation community and habitat degradation' has been decided as 'The highly cleared and modified landscapes of the Hawkesbury-Nepean catchment are already subject to erosion impacts and the increase in duration of inundation in wetland and floodplain zones is unlikely to substantially change the

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

existing erosion condition in the broader landscape.' Minor having the definition of 'Incidental and localised impacts to natural habitat.' It is understood that reducing the peak flood extents could have implications for species and communities that rely in these flood extents. However there is no scientific discussion around how these communities have had to adapt to the change in hydrological regimes due to the Warragamba Dam changing the previous flows and flood extents prior to the Dam, or what cumulative impact could this have on these communities and threatened entities. The potential impact identified as 'Increased duration of inundation in wetland and floodplain vegetation communities and habitats' has been identified as an Insignificant consequence'. Insignificant impact' defined as 'No measurable impact'. It is not as to how this conclusion has been drawn from scientific or evidence-based rationale. For example, has there been other examples of impacts that have occurred where the banks have been inundated with water for a substantial amount of time than what the environment has had to get used to since the dam was constructed which altered hydrological regimes? The EIS states "For areas within the FMZ discharge area, "*prolonged periods of inundation may have negative impacts on natural successional processes on plant and sedentary fauna species through vegetation damage and bank stability in wetland and floodplain communities".* This impact, however, is not expected to be permanent (up to an estimated 5 days) and is unlikely to result in significant modifications to the existing communities and habitats that are currently subject to wet periods and flooding events. Increased water flows into the Cumberland Plain's wetland and riparian habitats may potentially be beneficial for some aspects of wetland ecosystem health. This does not factor in that it may take much longer for this water to recede in some areas.

- In regard to Bank erosion and slumping resulting in vegetation community and habitat degradation as a result of the increase in low level flooding and flows within the FMZ discharge area the EIS states that *"the survey area is likely to result in increased bank erosion in discrete areas* along the main channel of the Nepean and Hawkesbury rivers. Riverbank erosion and bank slumping can be exacerbated by elevated river flows and soil saturation during periods of extended inundation. Changes to vegetation structure, composition, and condition may directly result from these changes to erosive processes for riparian, floodplain, and wetland communities. The area potentially impacted would be small and confined to vegetated areas on alluvial soils immediately adjacent to the main river channel. The EIS then downplays these impacts and does not assess that potential habitat would be inundated for greater periods of time leaving fauna susceptible without appropriate shelter habitat or foraging habitat for longer periods of time and susceptible to predation. The EIS recognizes this but then downplays or does not consider further species by species what could be impacted. This is considered to warrant further analysis and address.

- The following threatened Ecological communities were identified as being significantly impacted from the proposed development:

  1. Cumberland Plain Woodland in the Sydney Basin Bioregion
  2. River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions
  3. Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

4. Western Sydney Dry Rainforest

Threatened Flora

1. *Acacia pubescens*
2. *Callistemon linearifolius*
3. *Dillwynia tenuifolia*
4. *Eucalyptus benthamii*
5. *Grevillea juniperina* subsp. *juniperina*
6. *Micromyrtus minutiflora*
7. *Persoonia nutans*
8. *Pimelea spicata*
9. *Pomaderris brunnea*
10. *Pultenaea parviflora*
11. *Rhodamnia rubescens*
12. *Zieria involucrate*

Threatened Fauna

1. Australasian Bittern (*Botaurus poiciloptilus*)
2. Australian Painted Snipe (*Rostratula australis*)
3. Black Bittern (*Ixobrychus flavicollis*)
4. Cumberland Plain Land Snail (*Meridolum corneovirens*)
5. Green and Golden Bell Frog (*Litoria aurea*)
6. Regent Honeyeater (*Anthochaera phrygia*)

- The EIS states in Section 9.5.2 that The Project is unlikely to result in loss of vegetation cover but may change the structure and composition of vegetation communities over the long term. Potential fragmentation and patch size impacts are unlikely but structural changes in adjacent vegetation due to the project may exacerbate the current disturbance regimes and stressors, namely weed invasion, and lead to a subsequent loss of value within these biodiversity links and corridors. The Project acknowledges that there is a high level of uncertainty due to quantifying and qualifying the nature and scale of potential impacts, especially when the potential impact occurs at a landscape scale and any impact would be gradual over the long term. Due to the extent of the downstream catchment and the variability in catchment processes it is unlikely that monitoring would be able to differentiate between potential impacts resulting from the Project and from other downstream factors. In view of this, it is not proposed to provide offsets for potential downstream impacts.

- The offset strategy has referenced the SEARS noting that it stated *'11. Where a significant residual adverse impact to a relevant protected matter is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy*' and '*19. Where a significant residual adverse impact to a World Heritage property and/or a National Heritage place is considered likely the EIS must provide information on the proposed offset strategy. The offset strategy must: − (i) include a discussion and supporting evidence of the conservation benefit associated with the proposed offset strategy. The conservation benefit must demonstrate, at a minimum, how the − (ii) proposed offset will improve the integrity and resilience of the heritage values of the impacted heritage place or property; and − (iii) be consistent with the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offset*

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

Policy (2012): www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy or an endorsed state policy.' The strategy does not discuss how this has been achieved in the documentation supplied. The Warragamba Offset Program would be supported and complemented by the separate Environmental Management Plan (EMP) that WaterNSW is required to prepare under Part 5A of the Water NSW Act 2014 before the temporary inundation of any land protected by the National Parks and Wildlife Act 1974 can occur. The scope and content of the EMP have yet to be defined but would be consistent with the existing management plans for the national parks and the GBMWHA. The EMP would contribute to the maintenance and strengthening of protected lands values, including biodiversity.

- Should the Warragamba Dam Project be approved under the EP&A Act, the National Parks and Wildlife Minister is to determine the matters that are to be addressed by a draft EMP. If the project is to be approved the EMP should be made aware for comment. There are three key areas for a potential biodiversity stewardship agreement as part of the Warragamba Dam Raising Project:

  - protecting land owned by WaterNSW under a BSA
  - purchase of land and protection of land under a BSA
  - purchase of land and protection of land through inclusion in a national park under a Plan of Management.

  Based on the information provided there is no certainty or evidence that Water NSW will be able to secure offsets or be able to undertake the project and have a No-Net-Loss in respect to Biodiversity. Furthermore, further assessment and consideration of downstream impacts as well as further consideration of species that could be impacted upstream need to be undertaken to understand a more accurate extent of the proposed impacts of the Project.

- The likelihood table provided in Appendix G in Appendix F1: Biodiversity Assessment Report – Upstream states that there is high likelihood for *Pultenaea villifera* – endangered population as there is records for Yerranderie area and in Nattai National Park. Suitable habitat occurs within the study area. This is further supported in Table 5-5 Assessment of potential presence of species credit species states 'This population is located specifically in the Blue Mountains and Hawkesbury LGAs. A small proportion of the study area occurs within Blue Mountains LGA. The study area contains PCTs associated with the species.' However, in Table 7-2. Description of Project impacts on flora species credit species it states, 'No impacts as no habitat for this endangered population within the study area.' The only places this species is mentioned is in the three tables as mentioned and so therefore this species has been missed from offset calculations. This requires clarification.

- There are Expert reports for Red-crowned Toadlet, Giant Burrowing Frog, Green and Golden Bell Frog, Littlejohn's Frog, Stuttering Frog and Giant Barred Frog in the Construction Area Ecological Impact Assessment. It is not clear why The Giant Barred Frog, Stuttering Frog, Green and Golden Bell Frog was not considered as a potential species for the upstream ecological assessment. Chapter 8: Biodiversity-upstream states in Section 8.2.7.2 those expert reports were prepared for three amphibian species: Giant Burrowing Frog, Red-crowned Toadlet and Stuttering Frog but none of the upstream assessment reports include these expert

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

reports. The expert reports that have been provided for these species have only been prepared for Warragamba Construction area. Of further concern is the following:

- The expert reports have DRAFT watermarked on certain pages – it is unclear of these reports have been approved as a final version. This should be clarified.

- The downstream ecological impact assessment map book does not identify what the threatened flora records are – only shown in the legend as "NPWS Threatened Flora Species within Biodiversity Study Area" There is no explanation as to why these details are omitted from the maps.

- It does not appear that all of the study area have been site validated therefore there is high chances that threatened species have been missed and therefore the impacts underestimated.

- In relation to the Aquatic Ecology report, it is not agreed (as outlined in Section 3.7 of the report) that the only two key threatening processes relevant to the proposal will be:

  - The installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams; and

  - The removal of large woody debris from New South Wales rivers and streams.

  The proposal will also result in the degradation of native vegetation along New South Wales water courses.

  It is likely native vegetation will impact vegetation upstream due to longer periods of inundation. It is also likely that downstream will also incur impacts where flood prone vegetation communities, including riparian vegetation, will be inundated for longer periods which could result in the degradation of these environments. Further consideration and assessment of the consequences of this for aquatic ecology is needed.

  Section 4.2.2 of the report does not consider the increased time of inundation of riparian habitats. Furthermore, there appears to be missing information from Table 4-1 where on page 78 the last sentence in the third column ends and there is no continuation of the sentence on the following page which is blank. The following page (page 80) is also blank. This information needs to be made available.

- Overall, the proposal to raise Warragamba Dam will have considerable impacts on the environment, including World Heritage Values, notably biodiversity values and Aboriginal cultural heritage which on biodiversity grounds in isolation, suggests the proposal should not be supported.

  The Project will result in irreversible and uncertain impacts for biodiversity within the construction footprint as well as upstream and downstream of the project that has not been adequately addressed in the EIS. A number of species have been assumed present for lack of survey effort which without targeted surveys the report does not accurately assess the impacts to threatened species.

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

There could be additional species within the impact area that have not been considered assumed present or not detected through lack of survey effort. It is considered essential that the Environment, Energy and Science division of the NSW Department of Planning, Primary Industry and Environment commission an independent review of the documentation by relevant species and ecological experts to review the information provided in the EIS to ascertain whether the assessment has been undertaken in accordance with relevant survey guidelines for that species and the impacts accurately considered.

4. Water Quality Management Considerations

- With regards to the operational stages of the development, the project presents a number of potential impacts to water quality, creek stability and aquatic habitats. It is likely to occur either directly through operational activities, or indirectly through temporary inundation of upstream vegetated areas and soil landscapes during flood events within the flood management zone (FMZ), which may lead to an increase in organic and nutrient concentrations in Lake Burragorang. The project is also likely to present some risks to water quality during the operation of the flood management zone, which may have impacts on the raw water supply for drinking water purposes. Some of the key risks to water quality to the upstream environment as a risk of the increased extent and duration of the upstream catchment included increased natural organic matter concentrations, increase pathogens, turbidity, nutrient concentrations. The consent authority is requested to specifically address these concerns and likely impacts and ensure that are addressed and suitably mitigated via conditions of consent if the application is favorably determined.

- In terms of potential impacts caused discharge of the FMZ on downstream water quality, the EIS notes that temporary changes in water quality due to an extended period of discharge from the FMZ may be an issue as the discharge of the FMZ may extend into periods when downstream water quality would have recovered after a flood event. However, the information presented in the EIS concluded that the discharge of the FMZ would have no major impact on the downstream and noted that the FMZ would only be operational infrequently. The EIS also includes commitments to undertake further monitoring programs to confirm the risk and enhance adaptive responses to manage any changes in water quality due to the project. The consent authority is requested to specifically address the impacts of the FMZ discharge and ensure that are addressed and suitably mitigated via conditions of consent if the application is favorably determined.

- With respect to the geomorphological considerations, the reports noted there will be some unavoidable geomorphological impacts on bank erosion. The report considered a total of 16 potential impacts from the project and these included four potential impacts in the upstream study area, four potential impacts in the Lake area and eight potential impacts in the Downstream study area. The EIS further notes that during the emptying of the flood management zone (FMZ) there would be an increase in the duration of sustained flows through the river channel. This results in water levels within the river channel being maintained at higher levels for a longer period of time. The EIS noted that the FMZ

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

would be emptied at a constant rate of 100 gigalitres per day (1,160 cubic metres per second). The documentation also points out that this could be increased to around 230 gigalitres per day for larger floods allowing the FMZ to be emptied within three to four days. Potential impacts include the possibility of cumulative bank erosion impacts caused by prolonged FMZ flows in parts of the Nepean River, including in the Fairlight Gorge to Penrith Weir and Devlins Road to Grose Confluence reaches. The EIS indicates that the risks were considered to be relatively low with mitigation measures in place, which include the possibility of direct erosion mitigation measures. With respect to the impacts to the river, there was however limited discussion on impacts such as slumping riverbanks or loss of riparian vegetation because of the increased duration of inundation and resulting saturation of riverbanks. The consent authority is requested to specifically address these concerns and likely impacts and ensure that are addressed and suitably mitigated via conditions of consent if the application is favorably determined.

- If the application is supported by the Department, it will also be necessary to consider any impacts to channel stability to ensure that adequate safeguards and monitoring are in place to ensure any impacts are managed. Adequate consideration and resources should also be factored into the project to ensure that downstream landowners are not adversely impacted because of the project.

5. Environmental Management Considerations

- Limited information is provided within the EIS to address pollution management and sediment and erosion control measures for the demolition and construction phases of the development. Whilst these measures are to be put in place outside the Penrith City Council LGA, if they are not, then impacts could flow down river to our area. It is recommended that this be further addressed by the Department in the assessment of the application and via conditions of consent for the preparation of a Construction Environmental Management Plan (CEMP), prepared by a suitable qualified and practicing person detailing sediment and erosion control measures as well as pollution management strategies.

- It is recommended that a hazardous materials assessment is undertaken for both the demolition and construction phases of the development. Control measures should be included in this.

- There will be up to 500 workers travelling to site each day during construction as well as up to 104 heavy vehicles during the main works. Detail has been provided as to which route these vehicles will be travelling. It is recommended that heavy vehicles use these distinct travel routes only. These routes should be determined to have the least impact, both noise and air quality, on the residents of the Penrith City LGA. Furthermore, no truck movements should occur between the hours of 10pm and 6am (unless during an emergency such as floods).

- In relation to air pollution, the demolition and construction phases of the site is over 4km's away from residents of the Penrith City Council area. It is unlikely that our residents will be impacted by dust during demolition

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

and construction. Nevertheless, a Dust Management Plan should be prepared for the site.

- In relation to noise impacts, it is unlikely that the development will have direct noise impacts for residents of the Penrith City LGA. There may, however, be noise impacts from increased traffic, including heavy vehicles. These considerations should be included in a Construction Noise Management Plan.

- In respect to the above, it is suggested that there is an overarching CEMP for the site and that the Construction Noise Management Plan, Dust Management Plan, Pollution Management Plan, Sediment and Erosion Control Plan and any other sub-plans are formed under the CEMP. The CEMP and any plans should also include strategies for continuous monitoring and evaluation as well as strategies on dealing with complaints and adverse environmental outcomes.

6. Road and Drainage Asset Management Considerations

- In the event that the application is favourably determined, it is requested that conditions are imposed for a pre and post construction dilapidation report with respect to Silverdale Road between Park Avenue/Mulgoa Road and Blaxland Crossing at Nepean River (end of the Penrith LGA) including a detailed recording of the road pavement condition and bridge structure over the river. Any deterioration of these assets caused by the construction traffic routes through this area must be repaired at no cost to Council and to the satisfaction of Council's Asset Management Department. Any rectification works required will be subject to a 12-month maintenance period where should any further failures/deterioration of the repaired assets become apparent, these will need to be repaired again at no cost to Council.
- The requested dilapidation report outlined above should also include pre and post construction condition assessments of underground stormwater assets including pits and pipes. There are 450 mm diameter pipes on the road and CCTV inspections before and after use of road for heavy (project) traffic is required.

7. Traffic Management Considerations

In the event that the application is favourably determined, the following condition of consent are requested to be imposed:

- Prior to the issue of any Construction Certificate or the commencement of any construction works, the Certifying Authority shall ensure that a Construction Traffic Management Plan is provided to the satisfaction of Transport for NSW, and Wollondilly Shire Council and Penrith City Council that includes:

  1. All construction heavy vehicle movements to and from the east of the site to be via Silverdale Road, Park Road and The Northern Road only.
  2. All construction heavy vehicle movements across Blaxland's Crossing Bridge are controlled and monitored to be below the normal loading capacity of the bridge.

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

3. The speed limit for heavy vehicles on Blaxland's Crossing Bridge is reduced.
4. Impacts of heavy vehicle movements on Blaxland's Crossing Bridge structure and pavement and Silverdale Road pavement are controlled and monitored.

Conclusion and Recommendation

Given the significant matters raised by Council in relation to potential environmental impacts, it is submitted that the current proposal should not be supported based on the exhibited application and EIS.

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

Attachment 1 - Engineering and Flood Management Commentary

Review of Environmental Impact Statement – Warragamba Dam Raising

1. Purpose

The Water NSW, the owner and operator of Warragamba Dam, prepared an Environmental Impact Statement (EIS) for the proposed Warragamba Dam Raising for flood mitigation purposes and submitted a State Significant Infrastructure (SSI 8441) application to the Department of Planning, Industry and Environment (DPIE) to seek planning approval. The SSI, EIS and accompanying documents are currently on public exhibition. Council Floodplain and Drainage Engineering team has undertaken a review of the EIS and accompanying documents, particularly reference to the following chapters and appendices of the EIS that are related to flood modelling, flooding and associated results:

- Environmental Impact Statement – Executive Summary Report.
- Environmental Impact Statement – Chapter 15: Flooding and Hydrology.
- Environmental Impact Statement – Chapter 21: Socio-Economic, land use and property.
- Environmental Impact Statement – Appendix H1: Flooding and Hydrology Assessment Report.
- Environmental Impact Statement – Appendix H2: Flood Risk Analysis.

This report summarises the review outcomes and outlines the implication to Penrith LGA as the results of Warragamba Dam Wall Raising from flooding perspective. The review has been divided into three major sections:

1. Review of the flood models and flood modelling techniques undertaken to support the EIS.
2. Impacts of the proposed Raising Warragamba Dam Wall on areas of Penrith LGA.
3. Planning implications as a result of dam wall raising to Penrith City Council.

2. Background to EIS and Raising Warragamba Dam Wall

This section provides a brief description on the flood models and flood modelling techniques undertaken to support the EIS. The review comments and concerns raised are listed at the end of this section.

The Hawkesbury-Nepean Flood Risk Management Strategy 2016-2036 comprises a mix of infrastructure, non-infrastructure and policy measures that aim to preventing or mitigating floods, more coordinated and strategic planning in preparing for floods, including increasing ability to evacuate, and responding to and recovering from floods in the Hawkesbury-Nepean Valley. The preferred infrastructure option from the Hawkesbury-Nepean Flood Risk Management Strategy involves (INSW, 2016): *"introducing a flood mitigation function at Warragamba Dam by raising the dam wall by around 14 metres to reduce average annual flood damages to assets and social amenity and the risk to life".*

The Taskforce found that the most effective and efficient infrastructure option to reduce the significant risks to people's lives and property from regional flooding is to raise Warragamba Dam for flood mitigation.

Chapter 15: Flooding and Hydrology, Appendix H1: Flood and Hydrology Assessment Report and Appendix H2: Flood Risk Analysis have been prepared to provide technical guidance and inform the EIS.

The proposal to raise Warragamba dam wall by 14m is to create an airspace for temporary storage and controlled release of floodwaters to mitigate downstream flooding. The airspace called Flood Mitigation Zone will sit on top of the existing full water supply level. This flood

mitigation zone aims to hold the water from upstream catchment and then control releasing after the downstream peak flood is passed. It is estimated that this additional storage of water will be equivalent to 5% to 2.5%AEP storm event. The releasing operation of this additional storage water is very critical for downstream catchments.

Hydrological Modelling

The software product RORB has been used for the hydrological modelling. A special sub-routine, DAMROU, was added to the RORB program to model flow through the Lake Burragorang Reservoir taking account of the gate operations at the dam. The subroutine was modified as part of the Regional Flood Study to include simulation of the fuse plug operation on the auxiliary spillway (WMAWater, 2019).

As required by SEAR #8(3a), the following flooding events were assessed with and without dam raising:

- 20% AEP (approx. 1 in 5 chance in a year)
- 10% AEP (1 in 10 chance in a year)
- 5% AEP (1 in 20 chance in a year)
- 1% AEP (1 in 100 chance in a year)
- PMF (probable maximum flood).

The specific flood events used in the EIS assessment have been selected from the range of Monte Carlo flood events, as representative events for each of the AEPs specified in the SEARs. In addition, this assessment also examined the 0.5% AEP (1 in 200) and 0.2% AEP (1 in 500) events as required by the SEAR #8(3b) to assess potential climate change impacts.

Hydraulic Modelling

The hydraulic modelling of the flood flows undertaken as part of the EIS is based on the following flood models:

- *Upstream*: An existing MIKE 11 one-dimensional hydraulic model, which was originally developed in the 1990s to assess flow behaviour prior to the dam construction. The MIKE 11 model is used to assist in the calibration of the RORB model between the dam and the inflow gauges.
- *Downstream*: A quasi two-dimensional RUBICON model (hydrodynamic model software used to quantify the hydraulic aspects of flood behaviour) is used, which covered a river length of 360 kilometres and calibrated and verified against ten historical flood events. A quasi calibration was also undertaken using the TUFLOW model. Modelling has been extensively reviewed and endorsed by numerous Australian and international experts (WMAwater 2019). It should be noted that this RUBICON flood model has been developed as part of the “Hawkesbury-Nepean Valley Regional Flood Study, wmaWATER 2019”.
- The TUFLOW model was used to calibrate 10 historical events including a range of representative events. The historical events were November 1961, June 1964, June 1975, March 1978, August 1986, October 1987, April/May 1988, July 1988, April 1989 and August 1990. The model was considered suitable to give a general indication of the velocity distribution for the 1 in 100 AEP for the purposes of determining flood hazard and hydraulic categories. Further refinement and detailed bathymetry are required before this model is suitable for detailed modelling.
- The variables from the Monte Carlo analysis were fed to the RORB hydrological model, and the resultant flows, together with the other variables including relative timings of tributary inflows, tides and other variables, were fed into the hydraulic model.

- The MIKE11 and RUBICON models are a 1-dimensional (1-D) hydraulic model, which is based on a series of discrete cross sections that assumes a uniform water level across the section perpendicular to the direction of flow. The model outputs include a water level, flow rate and cross-section average flow velocity for each cross section for each model timestep. From these outputs, timeseries of water levels, flow rates and flow velocities can be generated for each event, and peak values for each parameter identified, for each event simulated.
- A slightly different analysis approach was adopted for the upstream area. The MIKE11 model was not used to discretely simulate each of the Monte Carlo design flood scenarios. Rather, the MIKE11 model was used to extract rating curves (flow-height relationships) under different dam raising scenarios. These rating curves were used to calculate level hydrographs from flow inputs (from the RORB model) at all cross-sections for the 20,000 Monte Carlo runs of the existing dam and the raised dam option. These level hydrographs were used to obtain estimates of inundation times upstream of the dam and to give an indication of the change in inundation time between the existing dam and the 14m raised dam option.

Flood Mitigation Zone (FMZ) Operation and Discharge

According to Section 4.2.4 of Appendix H1, operation of the FMZ would occur during significant rainfall events and when the water level in the dam is above the full supply level. For most rainfall events the dam would capture all flood inflows until uncontrolled spilling occurs. The timing and rate of discharge from the FMZ would be determined on a case-by-case basis. This statement will lead to question the discharging protocol used in this EIS to determine the flood impact on the projected dam wall raising on downstream floodplains.

The EIS claims that the most effective way of discharging the FMZ in a manner that restores the availability of the FMZ as soon as practical while minimising additional flooding impacts is to “piggyback” discharges after the peak flood level has been reached. Local catchment flooding causes the river to rise, in addition to any overflows from the dam. The FMZ holds upstream floodwaters behind the dam wall, thus reducing the downstream peak flood levels. FMZ releases are made after the flood at the downstream location has peaked; with a slight delay and a temporary fall in river levels whilst downstream peak is confirmed. The FMZ is then discharged at a rate that does not cause the river to exceed the previous flood level peak and is gradually reduced in stages. Therefore, the FMZ releases would not impact anywhere that had not already been affected by the preceding flood.

The maximum discharge rate through the new outlet conduits would be 230 gigalitres per day. This is equivalent to a **1 in 5 chance in a year flood event on the Richmond-Windsor floodplain**, and consequently piggybacking at this rate would be suitable for any downstream flood greater that a 1 in 5 chance in a year flood event. For smaller floods events, the discharge rate would need to be reduced to reflect peak flood levels.

Piggybacking of discharges would generally occur for only two to three days after the peak of a flood event, after which a constant discharge rate of about 100 gigalitres per day would be implemented. **For smaller flood events (1 in 20 chance in a year and lower), piggybacking would not be possible, and a constant discharge would need to be adopted.**

The potential impacts of the constant discharge rate of 100 gigalitres per day is an increase of 2.5m above the normal Nepean River level at Penrith. There will be limited access for road users from extended closure of low-lying bridges e.g. Yarramundi Bridge that could remain closed for up to 10 days longer with controlled releases from the dam.

3. Flood impact analysis undertaken for the EIS

Background:

The EIS provides a detailed flood impact assessment of the Warragamba Dam Wall Raising project (The Project). The assessment is primarily based on the flood models developed in 1996 as part of the Warragamba Dam Auxiliary Spillway Environmental Impact Study by WMAWater. These flood models were updated with minor details in a recently concluded Hawkesbury Nepean Regional Flood Study (2019) undertaken by WMAWater for Infrastructure NSW (INSW). Essentially the models from the 1996 study were adopted without major changes such as recalibration. However, a new methodology to define the design flood behaviour (1% AEP flood etc.) was used in this study and the existing flood behaviour as defined in the 1996 study was updated. The 2019 study did not assess the impact of the Project.

Currently, INSW is in the process of completing a detailed flood study for the Hawkesbury Nepean valley based on the latest flood modelling practices. This flood study would supersede the outcomes presented in the 2019 study.

Flood Modelling in EIS:

- The EIS primarily relies on the flood models developed for the 2019 study for the assessment of the Project. However, it appears that significant additional modelling was carried out for EIS to assess the impact of the Project. The information about this additional modelling is not properly presented in the EIS and how various outcomes have been achieved is not clear. This is discussed below using quotes from the EIS document related to flood modelling and followed by observations and comments.

  Executive Summary, Page 19 (referring to the recent March 2021 flood)

  "*This modelling by NSW Government post flood event has shown…..*"

  Executive Summary, Page 19 (note below Figure 18)

  Note: *Maps are based on modelling of March 2021 and February 2020 floods by Rhelm/Catchment Simulation Solutions for INSW; modelling of reduction in March 2021 peak flood level by WMAwater for INSW* ***Source:*** *INSW (2021)*

  Observation: It appears that the modelling work for EIS was being undertaken up until after the March 2021 floods. It is understood that this modelling work is being undertaken as per the recommendation of the 2019 study, where a detailed 2D modelling of the areas downstream of the dam was specified, to update the design flood behaviour as presented in the 2019 study. The reference for the "*Source: INSW (2021)*" is not provided in the EIS.

  Comment: Given that a more detailed model for the areas downstream of the dam is available, the impact of the Project should have been assessed using this detailed model. The 2D (TUFLOW) model used in the EIS is quasi-calibrated and can potentially present an incorrect assessment of Project's impact.

- Appendix H1, Page 12, *"The flood data presented in this report has been provided by WMAWater for INSW from studies undertaken as part of the ongoing floodplain risk management in the Hawkesbury-Nepean. No additional modelling has been undertaken by BMT or SMEC in preparation of this report, with existing modelling results provided by WMAWater considered fit for purpose."*

  Observation: The entire suite of modelling undertaken for the Project does not appear to have been peer reviewed, although part of the modelling, which was adopted from the previous studies has been peer reviewed.

Comment: Peer review should be undertaken for the complete set of modelling undertaken for the EIS to improve confidence in the outcomes of the EIS.

- Appendix H1, Page 13, *"As part of the Warragamba Dam raising Project, WMAwater was engaged by WaterNSW to undertake modelling of the increase in duration of temporary inundation during large inflow events upstream."*

  Appendix H1, Page 15, "*As part of the Warragamba Dam Raising Project, WMAWater has utilised an existing MIKE11 one-dimensional hydraulic model obtained from WaterNSW. The MIKE11 model was used to assist in the calibration of the RORB model between the dam and the inflow gauges."*

  Observation: An additional model (Mike 11) to the 2019 study has been used in the preparation of EIS. As stated, the Mike11 model was used to calibrate the RORB model, which can potentially modify the RORB model significantly and output from the newly calibrated RORB model can be significantly different from the outputs obtained in the 2019 study. This implies that the 2019 results presented in the EIS may potentially be incorrect.

  Comment: Details of further calibration of the RORB model for EIS should be documented. Any differences with the 2019 study should be highlighted.

- Appendix H1, Page 16 (as part of discussion of downstream RUBICON hydraulic model)

  Model calibration included:

  - *increasing the number of model sub-areas*
  - *calibrating the model at additional locations within the catchment*
  - inclusion of baseflows

  Observation: It appears that the RUBICON model has been further calibrated for the EIS. It has similar implications to the calibration of the RORB model as discussed above.

  Comment: Details of further calibration of RUBICON model should be included in the EIS. Differences with the 2019 study should be highlighted.

- Appendix H1, Page 16, *A quasi calibration was also undertaken using the TUFLOW model, which was run for 10 historical events including a range of representative events*.

  Appendix H1, Page 16, *The TUFLOW model was used to calibrate 10 historical events including a range of representative events. The historical events were November 1961, June 1964, June 1975, March 1978, August 1986, October 1987, April/May 1988, July 1988, April 1989 and August 1990.*

  Appendix H2, Page 4, *WMAwater has independently developed a TUFLOW model of the Hawkesbury-Nepean floodplain as part of a separate research project. This model has been adopted for the assessment of downstream impacts of a raised dam.*

  Appendix H2, Page 4, *The TUFLOW model is quasi-calibrated to historic events and representative design events from the Hawkesbury Nepean Regional flood study (2019).*

  Observation: It appears that a new TUFLOW ("research") model was developed for EIS and "quasi-calibrated" to historic events and representative design events from the 2019 study. No details about the "research" model and the "quasi-calibration" have been provided. It is also not clear if the new model was calibrated to the representative design events from the RUBICON model or the "poorly calibrated" TUFLOW model in the 2019 study (Appendix D, page D-3 of the 2019 study)

Comment: Details of the calibration of the new TUFLOW model should be provided in the EIS. Since the model is quasi-calibrated, sensitivity analysis should be undertaken to demonstrate that the model is fit for purpose.

Observation: Flood modelling results have been presented as maps for the existing conditions and those under the Project. It is difficult to visually compare the flood behaviour for the two conditions to assess impact.

Comment: Difference maps should be developed and included in the EIS to clearly highlight the impact of the Project.

Appendix H2, Page 6

In order to model a sustained release from Warragamba Dam during the drawdown phase a constant 100 GL/D flow on the Hawkesbury Nepean River was modelled. Minor inflows for the other tributaries were assumed.

- Appendix H1, Page 153

The timing and rate of discharge during inflow events would be determined on a case-by-case basis. Generally, the discharge of water from the FMZ during an inflow event would only occur

when there was a reliable prediction of significant future rainfall

when the discharge would not cause unacceptable downstream flooding impacts.

Observation: In Appendix H1, general principle for discharge of floodwaters form the dam has been specified. However, Appendix H2 provides details of the modelling undertaken for a specific discharge (100GL/day). The EIS does not provide a clear description of the protocol for discharge of floodwaters. The modelling appears to have been undertaken for a preliminary protocol developed by WaterNSW in 2017.

Comment: A detailed dam operation protocol should be developed for the dam operation and included in the EIS. This is discussed further in a following comment.

Observation: Flood modelling is critical to the assessment of the Project and provides the basis of support for the Project. Several models have been used for which details have not been provided. The description of the models presented is insufficient

Comment: The EIS should include a separate Appendix with details of the models used, the recalibration of models and how the calibrated models are deemed to be fit for purpose. The description of the models should be improved in the main document of EIS. As an example, in 8 above, it appears that the TUFLOW model was used to calibrate the RUBICON model. This is highly unlikely, however, if this process has been undertaken, it should be detailed in the EIS.

If text is copied from earlier studies, it should be highlighted in the EIS (italics etc.) for clarity.

Consideration should be given to have the entire EIS peer reviewed for such a significant project. EIS is the stage of the project where major changes in the concept design can be made, if identified by the peer review. An EIS that has been peer reviewed would also have a better chance of being supported by the stakeholders.

Dam Operation Protocol

- It appears that WaterNSW has developed a preliminary operation protocol for the dam operation during flooding in 2017 (Appendix H1, page 152). This operating protocol was

used to assess the impact of the Project. The operating protocol is based on achieving several objectives as presented on page 8 of Appendix H1.

- *ensuring the FMZ is emptied in sufficient time to capture a subsequent flood event*
- *minimising the duration of upstream catchment inundation*
- *not causing any increase in the extent of flooding downstream of the dam*
- *the need to keep downstream bridge river crossings open.*

On page 152 of Appendix H1, the EIS states, "*Raising the dam wall and creation of the FMZ would require modification of the operational rules of dam releases. An initial assessment and development of preliminary operating protocols was completed by WaterNSW (2017). These are shown on Figure 4-45 and summarised below. Final operational protocols will be further developed in conjunction with detailed design of the dam and in consultation with stakeholders responsible for flood management and emergency response in the downstream floodplain*."
Table1 presented in the Summary of the Appendix H1, provide recommendations for management of the flood risk impact from the Project. The table is copied below.

Table 1 Safeguards and management measures

Impact	***Environmental management measure***	***Responsibility***	***Timing***
Impacts during construction	*A Construction Flood Management Plan will be developed to minimise any changes in hydrology up and downstream of the dam and minimise risks to the construction site.* *A Dam Safety Emergency Plan will also be prepared in accordance with the requirements of Dams Safety NSW.*	*WaterNSW Construction Contractor*	*Pre-construction*
Impacts from operation of FMZ	*A detailed operational protocol for the operation of the FMZ will be developed in consultation with relevant downstream and upstream stakeholders.*	*WaterNSW*	*Operation*
Monitoring	*Investigate water monitoring systems to reflect Project changes in operational protocols.* *Investigate additional monitoring station downstream of the Kedumba River.*	*WaterNSW*	*Pre-operation*

Observation: The operation of the dam has been modelled based on a preliminary flood release protocol. It is not clear whether the operating protocol that has been modelled is optimum in achieving the objectives specified in the EIS. In addition, the current protocol has adverse impact downstream where several bridges would be inundated for a much longer duration for the modelled protocol. It is very surprising to note that a detailed assessment for the operation of the dam has not been undertaken as part of the EIS and has been postponed till the operation of the dam i.e. after the dam has been constructed.

Preparation of operating protocol is also one of the SEARs (No. 6) as presented on Page 15-4 of Chapter 15.

6. *The Proponent must detail a framework for managing water releases from the dam that are capable of meeting the objectives of the Project (in terms of flood mitigation), ensures impacts to upstream and downstream areas and ecosystems are minimised. The framework shall include consideration of the potential rates of rise and fall in the river,*

timing of water releases. These shall include consideration of antecedent, conditions within the river, flooding impacts, and transparent and translucent flows.

Comment: A detailed analysis of the dam operations should be undertaken, and an optimal dam operation protocol should be developed. By fixing the dam raising height to 14 m, an important variable in achieving an optimal solution for managing the flood impact of the Project has been constrained. Ideally, the operating protocol should have been investigated at the same time when the height for the raising of the dam was being investigated.

The operation protocol would also involve integration with a robust flood forecasting system specifically developed for the Project.

The flood evacuation strategy is also affected by the dam operations during floods. A detailed evacuation modelling should also be undertaken while developing the dam operating protocol.

Dam Failure Analysis

- Dam failure analysis is required for emergency planning for areas downstream of the dam. It appears that this has not been undertaken for the EIS. A dam break assessment for the existing conditions was undertaken in the 1996 study and reported in the 2019 study. The assessment identified an increase of approximately 4m in the PMF levels. With the raised dam wall, the increase in the PMF flood levels in the valley is likely to be much higher.

Observation: One of the Desired Performance Outcomes presented in the EIS on page 15-1 of Chapter 15 requires dam failure assessment. The requirement is copied below.

8. Flooding

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****.*

Although the dam failure assessment has not been reported, the Appendix H2 on page 4 states the following

"For this dam breach assessment, TUFLOW HPC has been adopted. TUFLOW HPC is a finite

volume model, which makes it very suitable for dam breach assessments. This is because it can handle steep waves and high velocities, and generally with good volume conservation."

From above, it appears that a dam failure analysis has been carried out but has not been reported.

Comment: The SEARs require dam failure assessment, which hasn't been undertaken as part of the EIS. This assessment is required to prepare emergency management and recovery plan.

In the event of the dam failure, the raised dam wall is likely to have adverse impact compared to the existing conditions. This impact needs to be assessed and shared with the Council, if this cannot be included

Water NSW should also provide details how the dam safety is being ensured under the Project.

Preservation of Flood Storage

- The Project would create additional storage in the dam for flood mitigation purposes. The Executive Summary of EIS states *"The Project does not change the permanent full water supply level of the dam and is solely to provide flood mitigation for downstream communities through the creation of a dedicated air space."*

  Comment: How would Water NSW ensure that the dedicated airspace for flood mitigation is not utilised by future requirements to store additional water for water supply purposes i.e. the supply level of the dam is not raised. Would this be legislated?

  Modelling Review Comments

  - The flooding results presented in Chapter 15: Flooding and Hydrology and in Appendix H1 for existing catchment conditions are based on the "Hawkesbury-Nepean Valley Regional Flood Study, wmaWATER 2019" prepared by INSW. This flood study assessed the flooding behaviour in the valley using the hydrological RORB model coupled with Monte Carlo modelling approach and 1D RUBICON hydraulic model that was developed as part of the Warragamba Dam EIS 1996. The Regional Flood Study 2019 did not assess the flood impact from the projected Warragamba Dam Wall raising scenario in the valley.
  - Chapter 15 and Appendix H1 refer to the Regional Flood Study 2019 when discussing about the assessment of the projected dam wall raising scenario. The details flood impact assessment of the projected dam wall raising including flood modelling on the valley is not clearly documented in this EIS.
  - The flooding hazard results presented in Appendix H2: Flood Risk Analysis are based on the TUFLOW HPC model prepared by wmaWATER for research purpose. Appendix H2 reported that the model was considered suitable to give a general indication of the velocity distribution for the 1 in 100 AEP for the purposes of determining flood hazard and hydraulic categories. Further refinement and detailed bathymetry are required before this model is suitable for detailed modelling. If the model still requires further refinement before it is suitable to define the flood behaviour, why it has been used in this EIS and what are the implications from its results on decision making – does it fit the purpose for such major project.
  - The "Hawkesbury-Nepean Valley Regional Flood Study, wmaWATER 2019" and associated 1 D RUBICON model has listed a series of limitations and recommendations that have not been considered in this EIS. Examples of limitations include the usage of the 1D RUBICON hydraulic model that doesn't account for the storages in the floodplains, the discrete location and distance between the cross-sections, absence of proper modelling of breakouts at Emu Plains and Boundary Creek. Example of recommendations include to undertake a detailed joint probability assessment to define the flooding behaviour for Wallacia area and the need for a detailed more contemporary 2D TUFLOW model to assess the flood behaviour in the Valley.
  - Based on the recommendation from the "Hawkesbury-Nepean Valley Regional Flood Study, wmaWATER 2019" INSW is currently in the process of finalising the assessment of flood behaviour in the valley using an updated and more contemporary TUFLOW HPC flood model with the sub-grid resampling approach. How the flood results presented in this EIS compared to the results generated from this updated TUFLOW model for existing condition and for the projected Dam Wall Raising scenario. It should be noted that Figure 18 in EIS Executive Summary EIS refers to the modelling undertaken by INSW to model the March 2021 with the raised dam wall scenario. However, there is no further discussions or details on the modelling for this event in Chapter 15 and Appendices H1 and H2.

- It is very critical for Council to understand the flood modelling and associate results for the existing catchment conditions before moving to the assessment of the projected Dam Wall Raising scenario. The results listed in Chapter 15 and Appendix H1 for existing conditions are still subject to further review and discussions. For instance, the 2019 Regional Flood Study recommended that more detailed investigation of the interaction of these Warragamba and Nepean Rivers is required ahead of any decision to amend existing flood plans or policies for Wallacia Village. This has not been addressed or discussed in this EIS. Therefore, the comparisons of the results between the existing and the projected dam wall raising scenario are subjective as the existing results still subject to change. In other word, the benefit from the dam wall raising will not be fully appreciated.
- It would be more practical if the flood model assessment and associated results in Chapter 15 and Appendices H1 and H2 are coming from one source as this will help in understanding the full benefit of the proposed scenario on the downstream floodplains.
- Table 3-13 of "Appendix H1: Flooding and Hydrology Assessment Report" shows that the velocities within the main river channel for existing conditions are unchangeable along the river and across the flood events. They are almost in the order of 1m/s. These results are of concern as other Council flood study results show that the magnitude of the velocity in the main channel is ranging from 2m/s to 4m/s depending on the location and the flood event.
- In Appendix H1, page 20 the EIS discusses the use of Mike 11 model as presented below

  "A slightly different analysis approach was adopted for the upstream area. The MIKE11 model was not used to discretely simulate each of the Monte Carlo design flood scenarios. Rather, the MIKE11 model was used to extract rating curves (flow-height relationships) under different dam raising scenarios. These rating curves were used to calculate level hydrographs from flow inputs (from the RORB model) at all cross-sections for the 20,000 Monte Carlo runs of the existing dam and the raised dam option. These level hydrographs were used to obtain estimates of inundation times upstream of the dam and to give an indication of the change in inundation time between the existing dam and the 14m raised dam option".

  Rating curves from a hydraulic model display hysteresis i.e. a looped rather than a single line relationship. How was the hysteresis affect considered? If an 'average" line was drawn through the loop for use in the above analysis, was there any sensitivity undertaken to assess the impact of this assumption Was any other assumption used to deal with the hysteresis effect.
- For the existing condition, there are discrepancies between the results presented in Chapter 15 and Appendix H1 versus the results presented in Appendix H2. For example, comparing figure 3-32 of Appendix H1 to figure 43 of Appendix H2. It looks like the results are coming from two different sources. Refer to the series of figures at the end of this documents to clarify this point.
- The hazard results presented in Appendix H2 need a second review as they are not consistence across the flood events. For instance, in the same area of Emu Plains the 1 in 100yr flood hazard is higher than the 1 in 500yr flood hazard. Refer to the series of figures at the end of this documents to clarify this point.
- In Appendix H2, the hazard results presented are also not consistence with the Hydraulic Categories results for the 1 in 100yr flood event in terms of extent. For instance, the hazard map doesn't show backwater via Boundary Creek while the

hydraulic categories mapping does show backwater. The same comments apply to the proposed dam wall raising maps.

- The flood level, flood depth and velocity maps for all design flood events for both existing and projected dam wall raising scenarios are missing from the flooding outcomes presented in EIS. Moreover, the inclusion of flood level difference maps for at least the 1 in 20yr, 1 in 100yr, 1 in 500yr and PMF events would be practical to visually appreciate the benefit of the projected dam wall raising.
- The flood modelling results presented in Chapter 15 and Appendices H1 and H2 show that for the projected dam wall raising scenario the flood levels are dropping dramatically for all designed flood events across Penrith LGA. Refer to Tables 15-20, Table 15-21, Table 15-22, and Table 15-23 of Chapter 15. Of interest are the changes in the 1 in 100yr flood event that show a drop-in flood level of 4.7m at M4 Motorway Bridge and 4.2m at Victoria Bridge. These outcomes need to be cautiously interpreted as the issues of the existing condition results are still under discussions and determination.

4. Impacts of EIS and Raising Warragamba Dam Wall on Penrith LGA

The review below provides details of the review results for four critical areas within Penrith LGA which are:

- Wallacia Village – Warragamba-Nepean River Backwater;
- Nepean River and its floodplain from Glenbrook confluence to Yarramundi Bridge;
- Rickabys Creek Catchment – Hawkesbury-Nepean Backwater; and
- South Creek Lower Reach – Hawkesbury-Nepean Backwater.

4.1 Area 1 – Wallacia Village

The flood levels difference between the existing condition and the proposed Warragamba Dam Wall raising scenario are presented in **Table 4-1**. The results are extracted from Table 15-22 of Chapter 15: Flooding and Hydrology at BLAXCROSS (Nepean River at Blaxland Crossing Bridge). Table 3-1 shows that the flood levels are dropping with the projected dam wall raise scenario for all design flood events. The benefit for flooding in Wallacia would occur when the release rate from Warragamba Dam for the projected dam wall raising scenario is lower than the existing situation. This would allow more water from the upstream Nepean River catchment to flow downstream rather than backing up and flooding Wallacia. This effect is most notable for floods greater than a 1 in 100yr flood event. This is clearly shown in **Table 4-1** where the flood levels difference is prominent for rare storm events i.e., 1 in 100yr up to PMF. For instance, the flood level is predicted to reduce by 2.6m for 1 in 100yr and by 2.8m for PMF. However, the flood levels difference for more frequent event e.g., 1 in 5yr and 1 in 10yr flood event is almost negligible. The flood levels are estimated to reduce by 0.2m for 1 in 5yr and by 0.1m for 1 in 10yr.

***Table 4-1**: Change in flood levels at Wallacia (Nepean River – Blaxland Crossing Bridge) due to Warragamba Dam Wall Raising Scenario and Council adopted flood levels.*

BLAXCROSS (Nepean River – Blaxland Crossing Bridge)							
Flood Event (1 in X chance in a year)	**5**	**10**	**20**	**100**	**200**	**500**	**PMF**
Existing Conditions (m AHD)	35.1	37.2	39.4	44.6	46.5	48.9	66.3
With Project (Dam Wall Raised and 100 GL/day discharge) (m AHD)	34.9	37.1	38.9	42	43.3	45.5	63.5
Change in flood levels (m)	-0.2	-0.1	-0.5	-2.6	-3.2	-3.4	-2.8
Council Adopted Flood Study Upper Nepean River FS (LMCE 1995) (m AHD)	N/A	N/A	42.8	45.8	N/A	N/A	56.9
Change in flood levels (m)	N/A	N/A	-3.9	-3.8	N/A	N/A	+6.6

The water level timeseries at BLAXCROSS (Nepean River at Blaxland Crossing Bridge) for existing and projected dam wall raising scenarios are presented in **Figure 4-1**. The model results show whilst the peak flood levels are reduced for rare flood events the shapes of the hydrographs have not changed dramatically at Wallacia Village. This means that the time allowed for evacuation between the two scenarios has not been enhanced. This is particularly true for the more frequent storm events up to 1 in 20yr flood event. Conversely, the peak flood levels for rare flood events are predicted to go down bringing the number of inundated properties also down. This means less people need to be evacuated during the projected dam wall raising scenario. In the PMF event there is not much difference, existing scenario remain unchanged even with the projected dam wall raising scenario.

Table 4-1 also shows the flood levels currently adopted by Council based on 1995 Upper Nepean River Flood Study. We compared the 1 in 100yr and the PMF flood levels of the projected dam wall raising scenario with the flood levels of 1995 Upper Nepean River Flood Study. For the 1 in 100yr event the 1995 Upper Nepean River Flood Study has a level of 45.9m AHD whilst the the projected dam wall raising scenario has a level of 42.0m AHD which is 3.9m lower than the levels predicted under the 1995 Upper Nepean River Flood Study. For PMF flood event the 1995 Upper Nepean River Flood Study has a level of 56.9m AHD whilst the projected dam wall raising scenario predicts a level of 63.5m AHD which is 6.6 meters higher. This means that even under the the projected dam wall raising scenario Wallacia area would be completely inundated during the PMF event.

It is clear from Chapter 15 and Appendices H1 and H2 that the flood modelling results for existing scenario are based on the “Hawkesbury-Nepean Valley Regional Flood Study, wmaWATER 2019” prepared for INSW. This study has recommended that further investigation of joint probability of Warragamba Dam and Nepean Rivers is needed to determine the flooding behaviour at Wallacia. There is no evidence in the EIS shows how this recommendation has been addressed. Hence, the comparison of the flood results between the existing and projected dam wall raising scenario is debatable as further analysis is required to define existing flood behaviour for Wallacia.

The benefit of the projected Dam Wall Raising scenario on Wallacia Village is prominent when floods reach or exceed the 1 in 100yer flood event. The flood levels for those rare events are predicted to be lower than current Council adopted flood levels. These outcomes are to be cautiously interpreted as the joint probability analysis has not been undertaken or simply not documented in this EIS. The benefit is very minimal in PMF event as Wallacia will be fully inundated even under the projected dam wall raising scenario.

The Wallacia area is situated in a critical location that could be flooded by the Nepean River flooding as well as from backwater flooding from Warragamba River (Dam overflow). There is

a necessity for further joint probability analysis to be undertaken for the existing and projected dam wall raising scenario to properly define the flooding behavior for Wallacia area. This exercise is currently considered by INSW as part of the update to the Hawkesbury-Nepean River Regional Flood Study. Therefore, without the joint probability analysis results of the interactions between the Warragamba and Nepean Rivers it is impractical to assess the benefits for Wallacia.

Figure 15-73. Wallacia: 1 in 100 chance in a year event

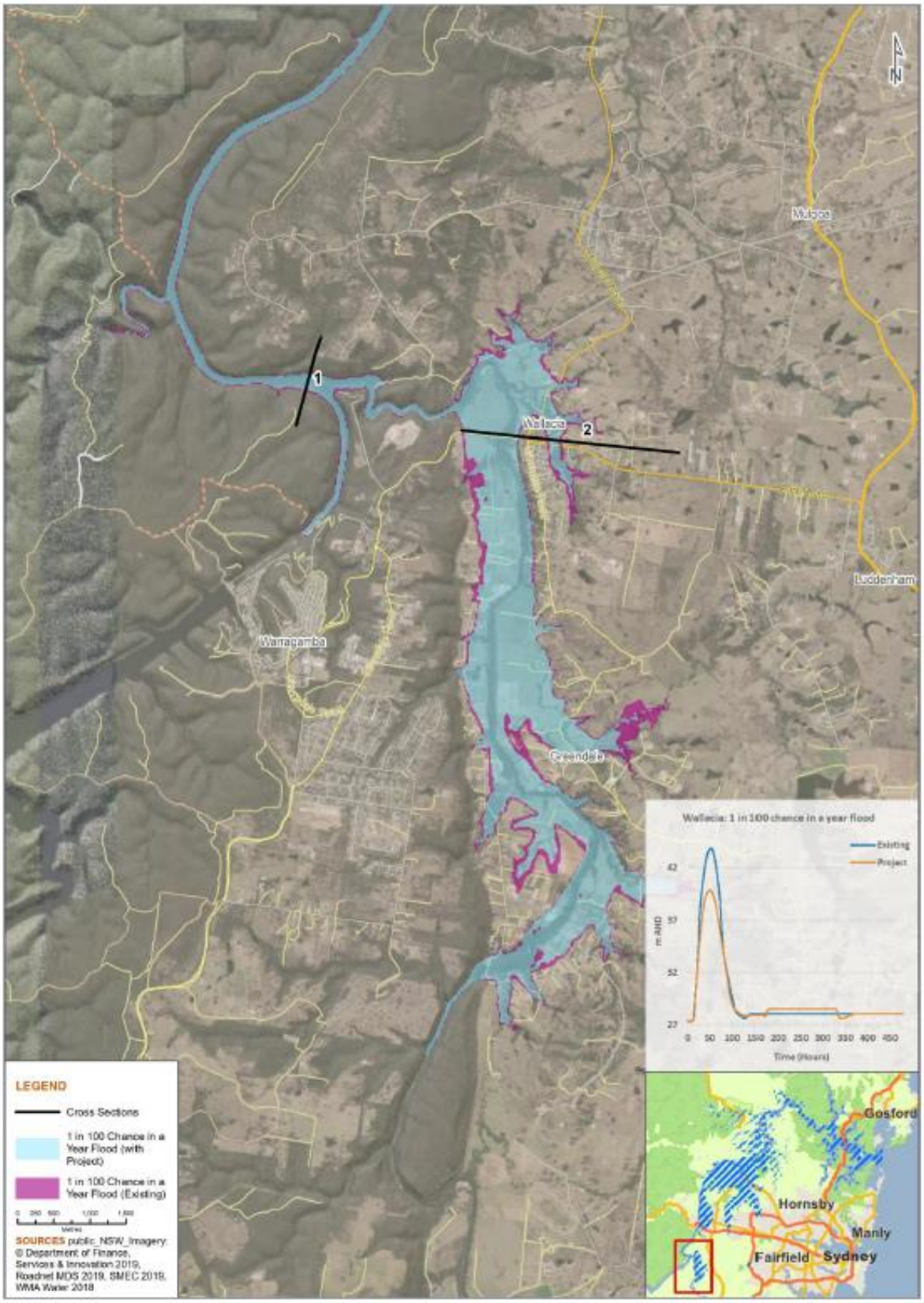


Figure 15-88. Wallacia: PMF

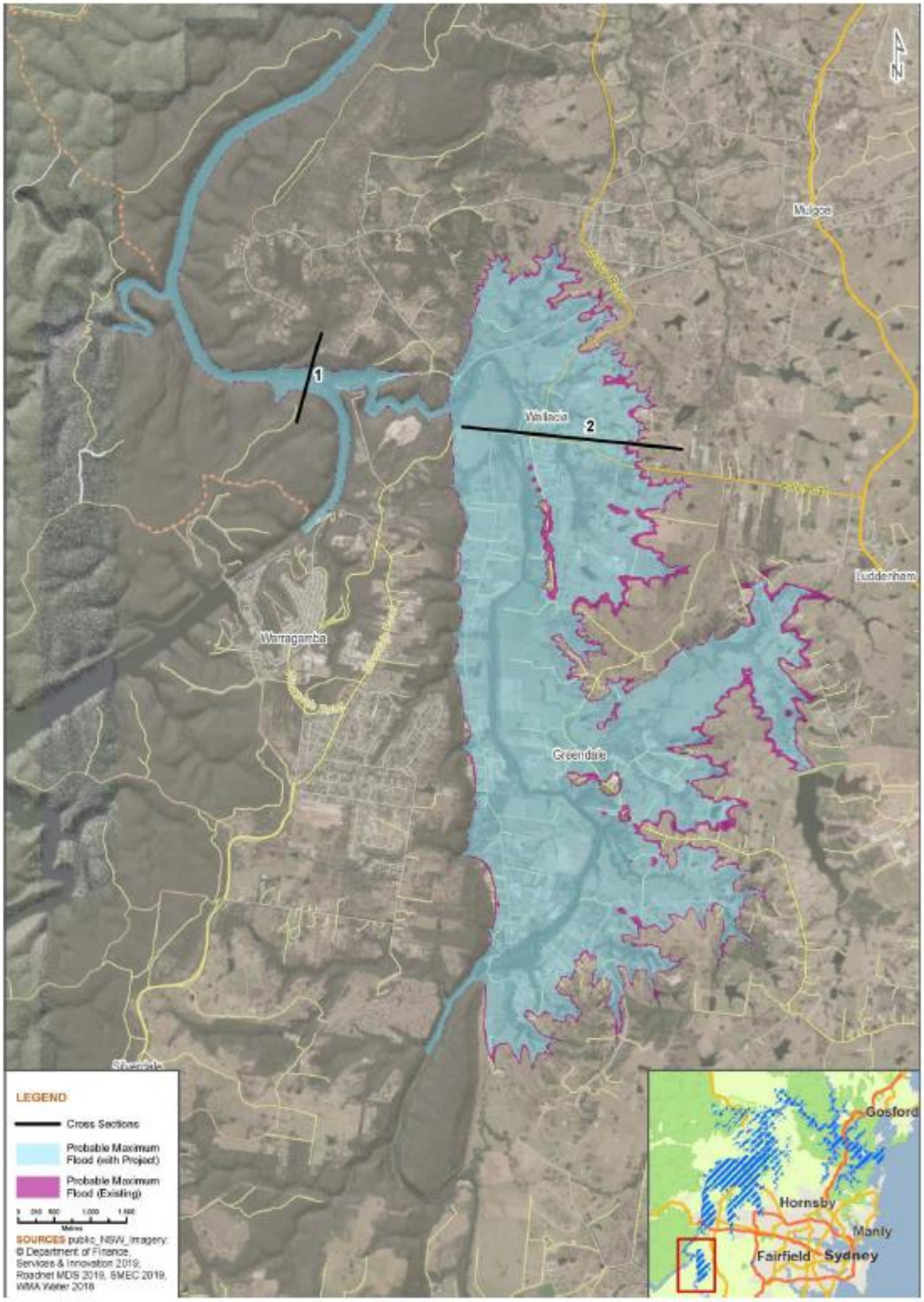
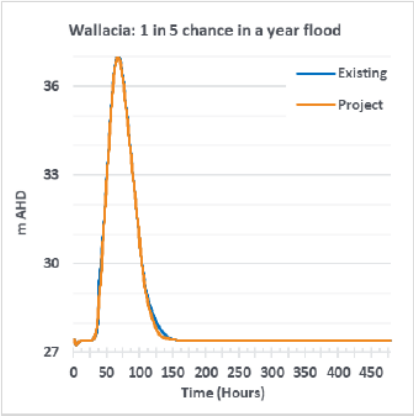
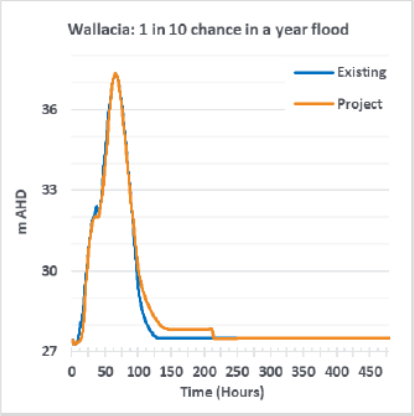


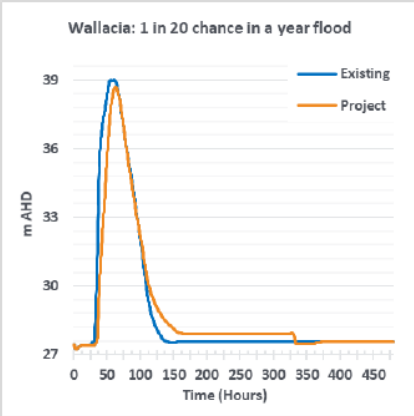
Figure 4-1: Water Level Timeseries at BLAXCROSS (Nepean River at Blaxland Crossing Bridge) (Source Table 15-21 of Chapter 15)



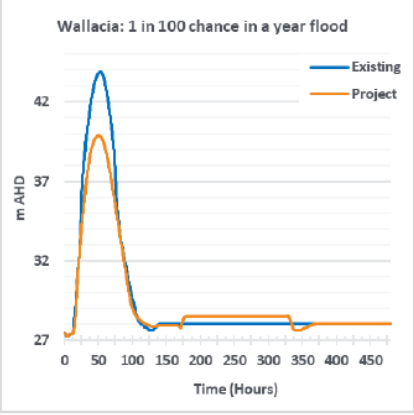
The Project would result in minimal change in existing flooding extents. However, existing flooding does not result in substantial damage or impacts



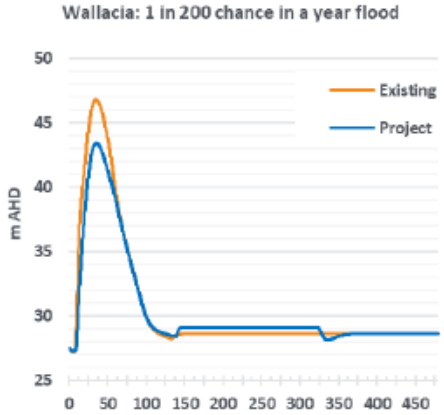
The Project would result in minimal change to existing flooding extents. However, existing flooding does not result in substantial damage or impacts



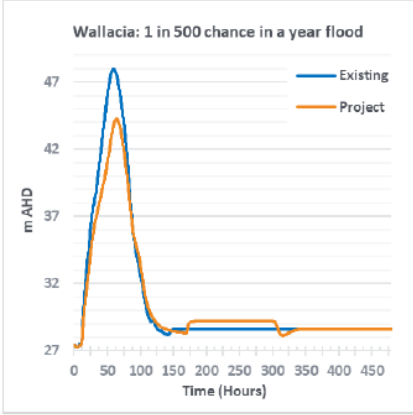
The Project would result in a minimal change in existing flooding extents. However, existing flooding does not result in substantial damage or impacts



The Project would result in minimal change in existing flooding extents, although some low-lying development areas would be better protected.



The Project would result in a minor reduction from existing flooding extents, particularly along the eastern side on Wallacia and agricultural land to the south.



The Project would result in a minor reduction from existing flooding extents, particularly along the eastern side on Wallacia and agricultural land to the south.

4.2 Area 2 – Nepean River and its floodplain between Glenbrook Confluence and Yarramundi Bridge

Review of the Chapter 15 and Appendices H1 and H2 of the EIS reveals that the flood levels from the projected dam wall raising scenario are dramatically lower than the flood levels for existing condition for all design flood events. The flood levels difference between the existing condition and the proposed Warragamba dam wall raising scenario are presented in **Table 4-2**. The results are extracted from Table 15-20 of Chapter 15: Flooding and Hydrology and Table 3-1 of Appendix H1 for the relevant cross-sections. As shown in Table 3-2, with the projected dam wall raising scenario the flood levels for 1 in 100yr for are reduced by 4.7m at M4 Motorway Bridge, by 4.1m at Victoria Bridge and by 4.3m at MILLDAM 1 (Devlin Road). While for PMF the flood levels are predicted to be lower by 1.3m at M4 Motorway Bridge, by 1.5m at Victoria Bridge and by 1.6m at MILLDAM 1 (Devlin Road).

For the Nepean River between the M4 motorway and Victoria Bridge, most flood impacts and flooding of urban areas (e.g., Emu Plains) would occur once flood levels approaching or exceed the existing 1 in 100yr flood level. With the projected dam wall raising it is prominent that the flood level in the 1 in 500yr flood level would be lower than the existing 1 in 100yr flood level at Victoria Bridge cross section. For instance, existing 1 in 100yr flood level at Victoria Bridge is 25.8m AHD while with projected dam wall raising the 1 in 500yr flood level is 25.4m AHD. This reduction in flood levels will provide flood immunity to Emu Plains area up to 1 in 500yr flood event. A comparison of the flood extent maps for 1 in 100yr and PMF events are extracted from Chapter 15 and are presented below.

The water level timeseries for different design flood events at F4BRIDGE (Nepean River – M4 Motorway bridges) for existing and projected dam wall raising scenarios are presented in **Figure 4-2**. Similarly, the water level timeseries for other cross-sections are also presented in **Figure 4-3**. It is evident that both the flood frequencies and the shape of the timeseries are changed with the projected dam wall raising scenario. In addition to reducing the peak flood levels and associated flood extents, a raised dam wall will alter the period of inundation and rate of rise of floodwaters, allowing more certainty of time for people to evacuate, protecting lives, and reducing damages.

Raising dam wall will create a flood mitigation zone that seats on top of the existing full supply level of the dam. This flood mitigation zone would delay and attenuate the progression of inflows coming from the upstream Warragamba Catchment, which in turn would reduce the severity of regional flood events impacting on the downstream floodplains. The concept of releasing of the stored water in the flood mitigation zone after the peak of flood has passed will reduce the peak flood levels but will have negative impacts on the downstream low-lying areas e.g., Yarramundi Lagoons. This area would experience a longer duration of low-level river flows as flood waters recede compared with how the existing dam operates. This change in operation would result in potential limited access for road users from the extended closure of low-lying bridges during releases from the flood mitigation zone. For instance, the low-lying Yarramundi Bridge could remain closed for hours and up to around 10 days longer with the controlled releases from the dam (Source Figure 32 of EIS Executive Summary).

Council adopted flood levels from Penrith's Nepean River Flood Study 2018 are also listed in **Table 4-2**. Investigations reveal that the flood levels from the Nepean River Flood Study 2018 are generally higher than the flood levels from the projected dam wall raising scenario for all design flood events except for PMF. For instance, at Victoria Bridge the 1 in 100yr event the Nepean River Flood Study 2018 has a level of 26.3m AHD whilst the projected dam wall raising scenario has a level of 21.6m AHD which is 4.7m lower than the levels predicted under the Nepean River Flood Study 2018. With the projected dam wall raising it is prominent that the flood level in the 1 in 500yr flood level would be lower than the existing 1 in 100yr flood level at Victoria Bridge. For instance, the adopted 1 in 100yr flood level at Victoria Bridge is 26.3m AHD while with projected dam wall raising the 1 in 500yr flood level is 25.4m AHD. A reduction

in flood level by 0.9m. This reduction in flood levels will provide flood immunity to Emu Plains area up to 1 in 500yr flood event.

In PMF event, the Nepean River Flood Study 2018 has a level of 31.1m AHD whilst the projected dam wall raising scenario predicts a level of 31.4m AHD which is 0.3m higher at Victoria Bridge. While at MILLDAM 1 (Devlin Road) the Nepean River Flood Study 2018 has a level of 27.0m AHD and the projected dam wall raising scenario predicts a level of 29.8m AHD which is 2.8m higher. Table 3-2 shows that the flood levels from the wall dam raising scenario are higher than the adopted PMF levels.

The benefit of reducing the flood levels across the area is also resulted in reducing the number of inundated properties. At Penrith, the review assessment reveals that the number of residential properties affected by a 1 in 20yr event is currently estimated to be 70, which would reduce to fewer than 10 under the projected dam wall raising scenario. For a 1 in 100yr event there are currently an estimated 1,700 residential properties which would be affected. This number is predicted to reduce to 80 residential properties under the projected dam wall raising scenario, which represents a reduction of 95 percent. In a 1 in 1,000yr event, an estimated 7,200 residential properties would be affected and 150 manufactured homes. Under the projected dam wall raising scenario the number of residential properties affected in the Penrith LGA would be reduced by 65 percent, with the number of manufactured homes affected reducing from 150 to 70 homes. For a 1 in 100yr event it is estimated that 70 commercial and industrial properties would currently be affected. Under the projected dam wall raising scenario, this number would reduce to zero. The number of properties supporting rural activities currently affected by a 1 in 100yr event is estimated to be 790, which would reduce to 200 under the projected dam wall raising scenario, a reduction of 75 percent.

The flood modelling and model results presented in EIS are based on the Regional Flood Study 2019 that recommended the development of a detailed 2D TUFLOW model to define the flood behaviour in the Valley. In addition, the results are coming from two different flood modelling sources e.g. RUBICON and TUFLOW making it hard to have a conclusive decision about the EIS. That said, the projected dam wall raising flood results presented in the EIS are promising. They offer several benefits for the Nepean River and its floodplains that are located between Glenbrook Confluence and Yarramundi Bridge. The projected dam wall raising will result in lower peak flood levels compared to Council adopted flood levels. There will be less inundated property and hence less flood damage / risk. The potential negative impacts include longer periods of low-level flooding and flood hazard, disruption to transport and businesses as well as an increase in the risk of bank erosion. Examples include an increase of 2.5m above the normal Nepean River level at Penrith. There will be limited access for road users from extended closure of low-lying bridges e.g. Yarramundi Bridge that could remain closed up to 10 days longer with controlled releases from the dam

***Table 4-2**: Change in flood levels at Nepean River between Glenbrook Confluence and Yarramundi Bridge due to Warragamba Dam Wall Raising Scenario and Council adopted flood levels.*

Flood Event (1 in X chance in a year)	**5**	**10**	**20**	**100**	**200**	**500**	**PMF**
Existing Conditions (m AHD)							
F4BRIDGE (Nepean River – M4 Motorway bridges)	20.6	22.7	24.9	27.6	28.4	29	34.9
Victoria Bridge cross-section	19.6	21.3	23.3	25.8	26.5	27.1	32.7
BONNEVALE (Nepean River - Downstream of Penrith Weir)	14.9	17.8	20.5	23.5	24.3	25.3	32.5
MILLDAM 1 (Nepean River - at Castlereagh)	12.9	15.6	18	20.4	21.4	22.7	31.4
With Project (Dam Wall Raising and 100 GL/day discharge) (m AHD)							

F4BRIDGE (Nepean River – M4 Motorway bridges)	17.9	18.8	19.6	22.9	24.9	27.2	33.6
Victoria Bridge cross-section	17.5	18.2	18.8	21.6	23.3	25.4	31.4
BONNEVALE (Nepean River - Downstream of Penrith Weir)	11	12.5	13.8	18.3	20.7	23.1	31
MILLDAM 1 (Nepean River - at Castlereagh)	9.4	11	12.3	16.1	18.2	20	29.8
Change in flood levels (m)							
F4BRIDGE (Nepean River – M4 Motorway bridges)	-2.7	-3.9	-5.3	-4.7	-3.5	-1.8	-1.3
Victoria Bridge cross-section	-2.1	-3.1	-4.5	-4.2	-3.2	-1.7	-1.3
BONNEVALE (Nepean River - Downstream of Penrith Weir)	-3.9	-5.3	-6.7	-5.2	-3.6	-2.2	-1.5
MILLDAM 1 (Nepean River - at Castlereagh)	-3.5	-4.6	-5.7	-4.3	-3.2	-2.7	-1.6
Council Adopted Flood Study - Nepean River Flood Study 2018 (m AHD)							
F4BRIDGE (Nepean River – M4 Motorway bridges)	N/A	N/A	25.0	28.2	29.3	29.8	32.5
Victoria Bridge cross-section	N/A	N/A	23.4	26.3	27.3	28.1	31.1
BONNEVALE (Nepean River - Downstream of Penrith Weir)	N/A	N/A	22.8	25.6	26.6	27.2	30.2
MILLDAM 1 (Nepean River - at Castlereagh)	N/A	N/A	17.6	20.4	21.5	22.4	27.0
Change in flood levels (m)							
F4BRIDGE (Nepean River – M4 Motorway bridges)	N/A	N/A	-5.4	-5.3	-4.4	-2.6	+1.1
Victoria Bridge cross-section	N/A	N/A	-4.6	-4.7	-4.0	-2.7	+0.3
BONNEVALE (Nepean River - Downstream of Penrith Weir)	N/A	N/A	-9.0	-7.3	-5.9	-4.1	+0.9
MILLDAM 1 (Nepean River - at Castlereagh)	N/A	N/A	-5.3	-4.3	-3.3	-2.4	+2.8

Figure 4-2: Water Level Timeseries at F4BRIDGE (Nepean River at M4 Motorway Bridge) (Source Figure 4-32 of Appendix H1)

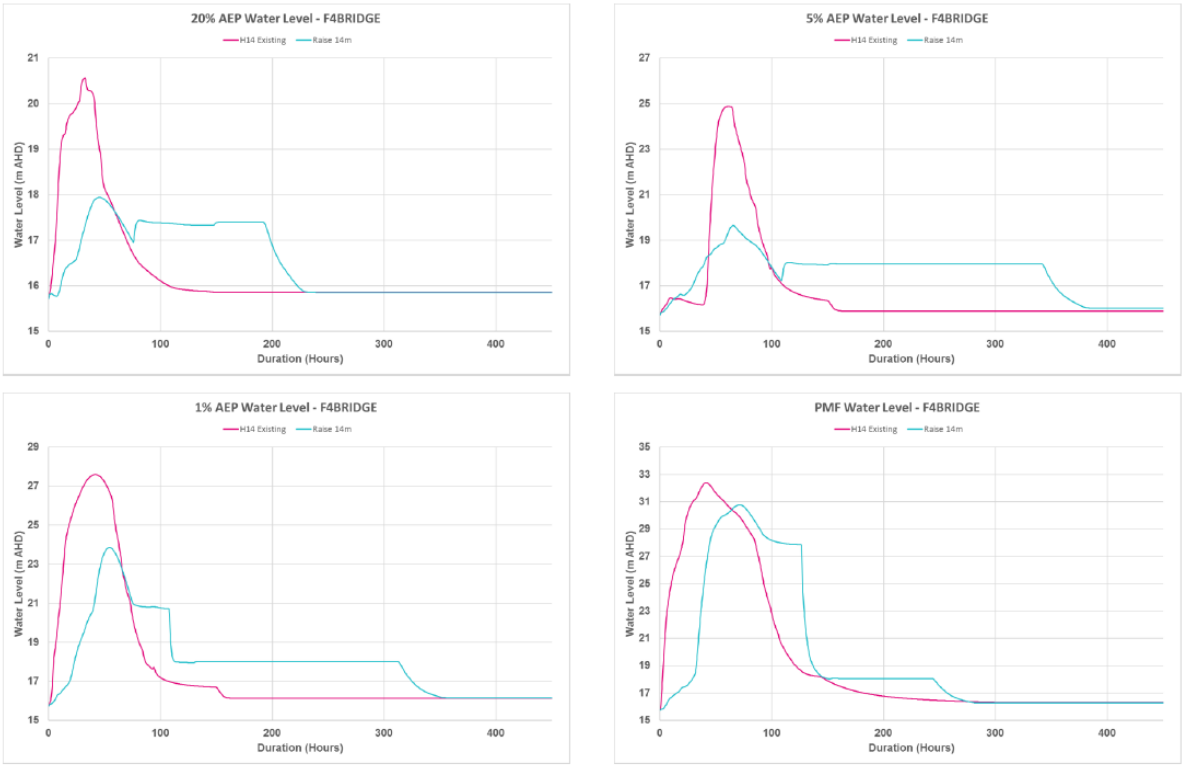


Figure 4-3: Water Level Timeseries for 1 in 100yr (Source Figure 4-33 of Appendix H1)

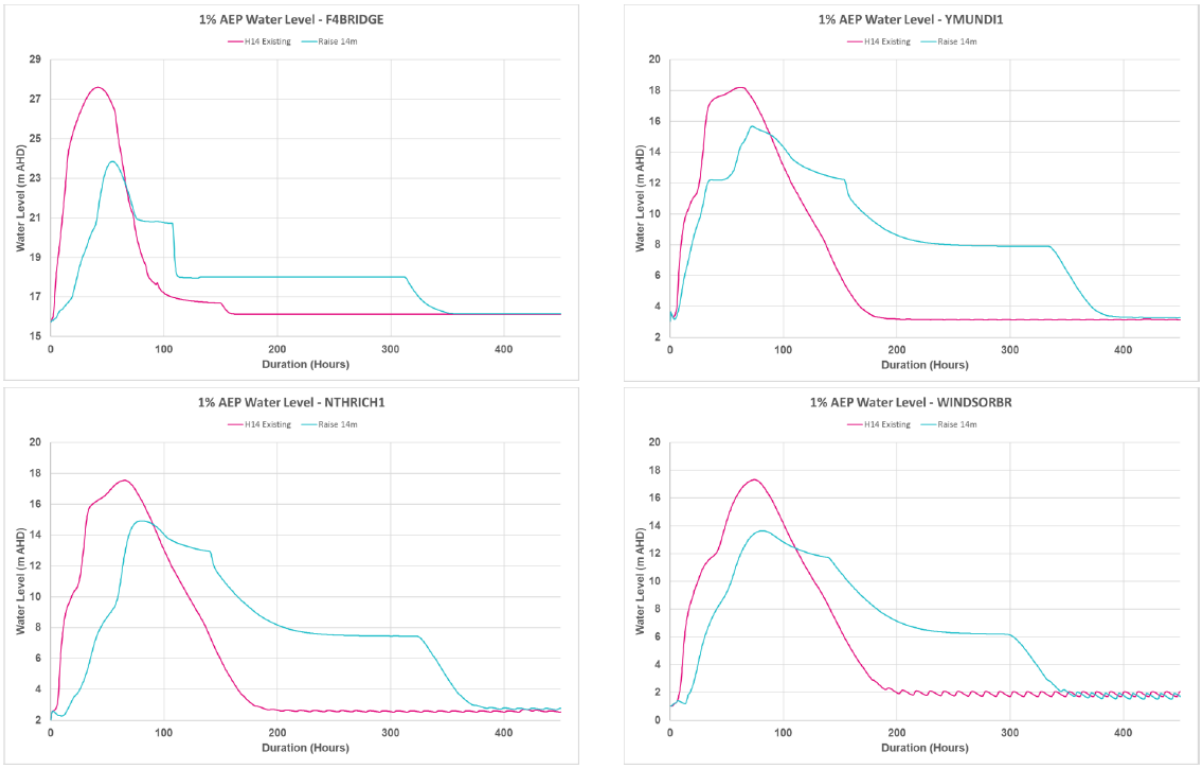


Figure 15-74. Penrith: 1 in 100 chance in a year event

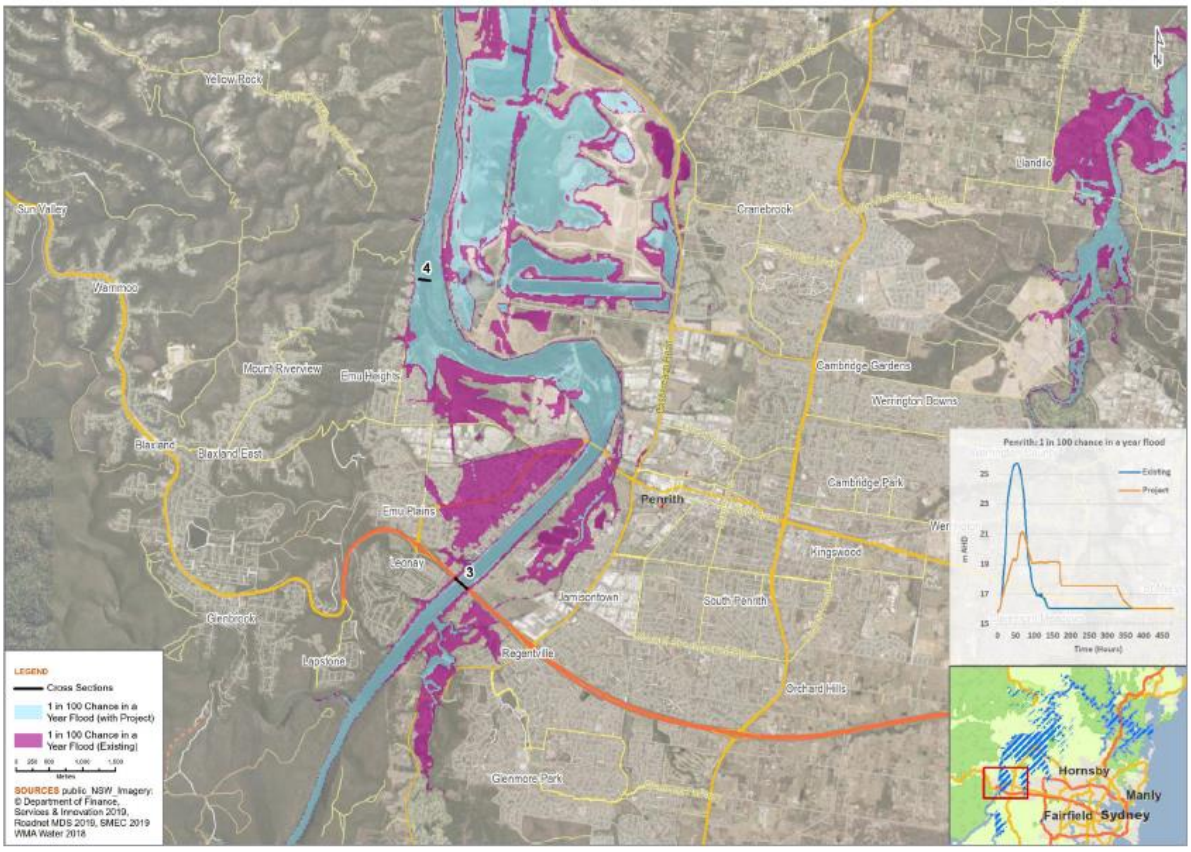
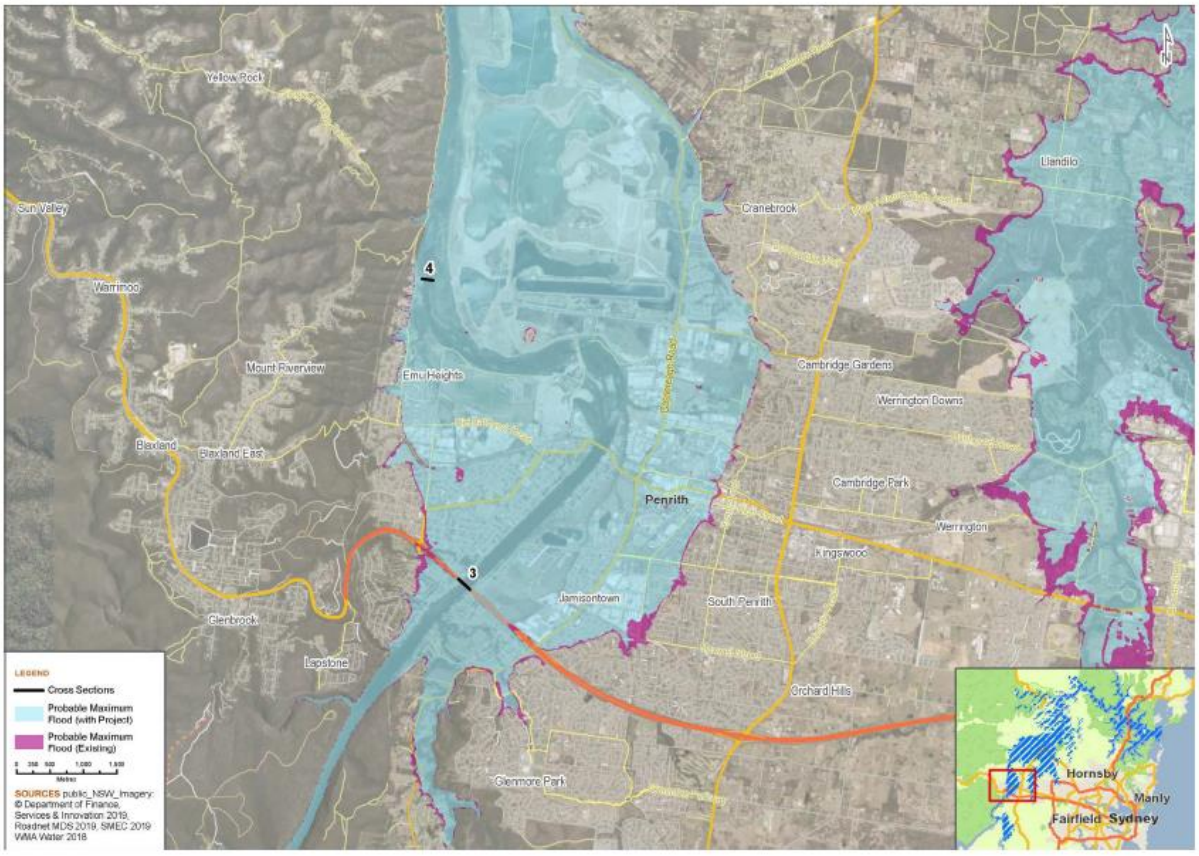


Figure 15-89. Penrith: PMF



4.3 Area 3 – Rickabys Creek and South Creek (Hawkesbury-Nepean River Backwater)

The Hawkesbury-Nepean River backwater flood levels via Rickabys Creek at Londonderry for existing condition and proposed Warragamba Dam Wall raising scenario are presented in **Table 4-3**. These results are sourced from Table 15-20 of Chapter 15: Flooding and Hydrology and Table 3-11 of Appendix H1 for LDERRY (Rickabys Creek at Londonderry). **Table 4-3** also shows the flood levels difference between the two scenarios. The projected dam wall results are very promising as the backwater flood levels are reduced dramatically across all design flood events including the PMF. For instance, the existing backwater flood level for the 1 in 100yr event (17.3m AHD) is predicted to be lowered to 13.3 m AHD.

Table 4-3*: Change in flood levels at LDERRY Cross-section (Rickabys Creek at Londonderry) due to Warragamba Dam Wall Raising Scenario.*

LDERRY (Rickabys Creek at Londonderry)							
Flood Event (1 in X chance in a year)	**5**	**10**	**20**	**100**	**200**	**500**	**PMF**
Existing Conditions (m AHD)	10.1	12	13.8	17.4	18.4	19.6	26.7
With Project (Dam Wall Raising and 100 GL/day discharge) (m AHD)	9.3	9.7	10.6	13.3	14.8	16.8	25.1
Change in flood levels (m)	-0.8	-2.3	-3.2	-4.1	-3.6	-2.8	-1.6

The Hawkesbury-Nepean River backwater flood levels via South Creek at Richmond Road Bridge for existing condition and proposed Warragamba Dam Wall raising scenario are presented in **Table 4-4**. These results are sourced from Table 15-20 of Chapter 15: Flooding and Hydrology and Table 3-11 of Appendix H1 for RICKWALK (South Creek at Richmond Road Bridge). **Table 4-4** also shows the flood levels difference between the two scenarios. The projected dam wall raising results are very encouraging as the backwater flood levels are reduced dramatically across all design flood events including the PMF. For instance, the existing backwater flood level for the 1 in 100yr event (17.3m AHD) is predicted to be lowered to 13.2 m AHD.

Table 4-4*: Change in flood levels at RICHWALK Cross-section (South Creek at Richmond Road Bridge) due to Warragamba Dam Wall Raising Scenario.*

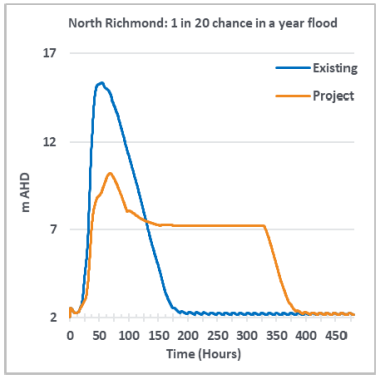
RICHWALK (South Creek at Richmond Road Bridge)							
Flood Event (1 in X chance in a year)	**5**	**10**	**20**	**100**	**200**	**500**	**PMF**
Existing Conditions (m AHD)	9.8	11.9	13.7	17.3	18.3	19.6	26.7
With Project (Dam Wall Raising and 100 GL/day discharge) (m AHD)	7.7	9	10.2	13.2	14.7	16.7	25
Change in flood levels (m)	-2.1	-2.9	-3.5	-4.1	-3.6	-2.9	-1.7

The timeseries graphs for Windsor Bridge are not supplied in the EIS, as an alternative the water level timeseries for North Richmond (sourced from Table 15-21 of Chapter 15) are presented in **Figure 4-4** to provide an indication of the rate of rise relevant to South Creek and Rickabys Creek areas. While, the peak flood levels and associated flood extents are reduced, there are now longer period of low flood to drain the water from the raised dam wall mitigation zone. This will alter the period of inundation and rate of rise of floodwaters, allowing more certainty of time for people to evacuate, protecting lives, and reducing damages.

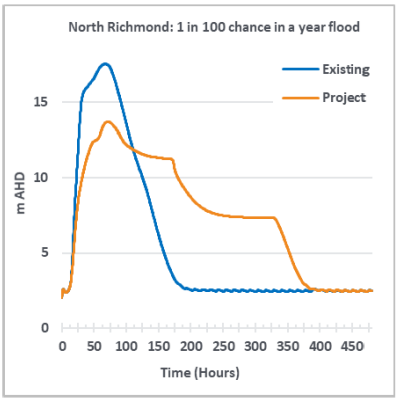
Currently for Rickabys Creek area Council uses the flood information from the “Hawkesbury-Nepean Valley Regional Flood Study, wmaWATER 2019”. For South Creek Council is using

the South Creek Flood Study, Worley Parsons 2015. For both areas, the dam wall raising provides positive benefit as the backwater flood level is reduced significantly and hence the number of properties inundated. The impact of the projected dam wall raising on downstream PMF flood extents and durations is minimal as the proposed wall raising scenario would only capture a very small proportion of inflows and consequently the difference between downstream existing and projected PMF impacts is relatively small.

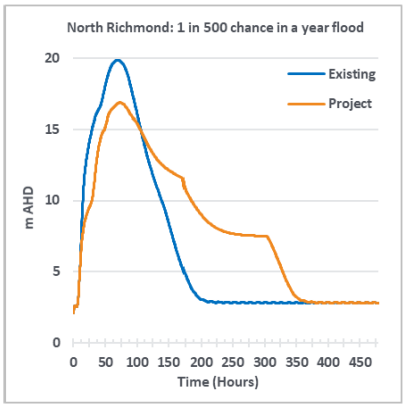
Figure 4-4: Water Level Timeseries at North Richmond (Source Table 15-21 of Chapter 15)



The Project would reduce overbank flooding; however substantial areas of overbank flooding would remain. The Project would reduce flooding of fringes of residential areas in Wilberforce, Pitt Town, South Windsor, and McGraths Hill. Similarly, the Project would reduce lateral and upstream flooding along South Creek, Riverstone, and Vineyard.

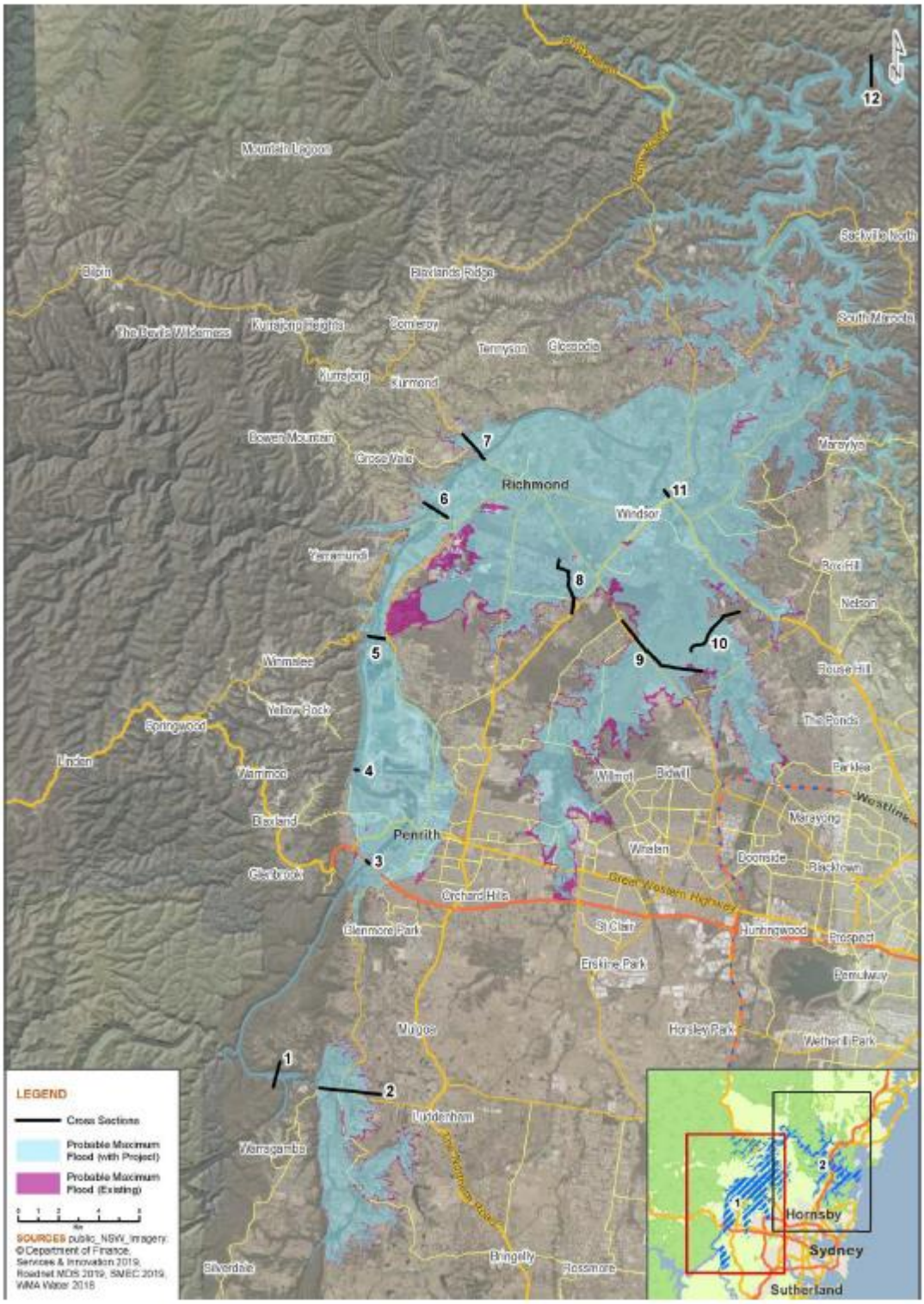


The Project would reduce urban flooding in Pitt Town, Bligh Park, South Windsor, and Windsor. Clarendon and McGraths Hill, which would be totally flooded under existing conditions, would be largely flood-free with the Project. The Project would substantially reduce flooding in Riverstone, Vineyard and Schofields.



The Project would have a minor reduction in flooding extents in Pitt Town, South Windsor, Windsor, Mulgrave, and Oakdale. The Project would result in a major reduction of flooding extents in Richmond, Bligh Park and Londonderry. Clarendon, Mulgrave, and McGraths Hill would be totally flooded. The Project would result in a minor reduction in flooding extents in Riverstone, Vineyard and Schofields.

Figure 15-87. Downstream flood extent: PMF



The following maps present the comparison of the flood hazard and the areas of concerns raised in the review comments above

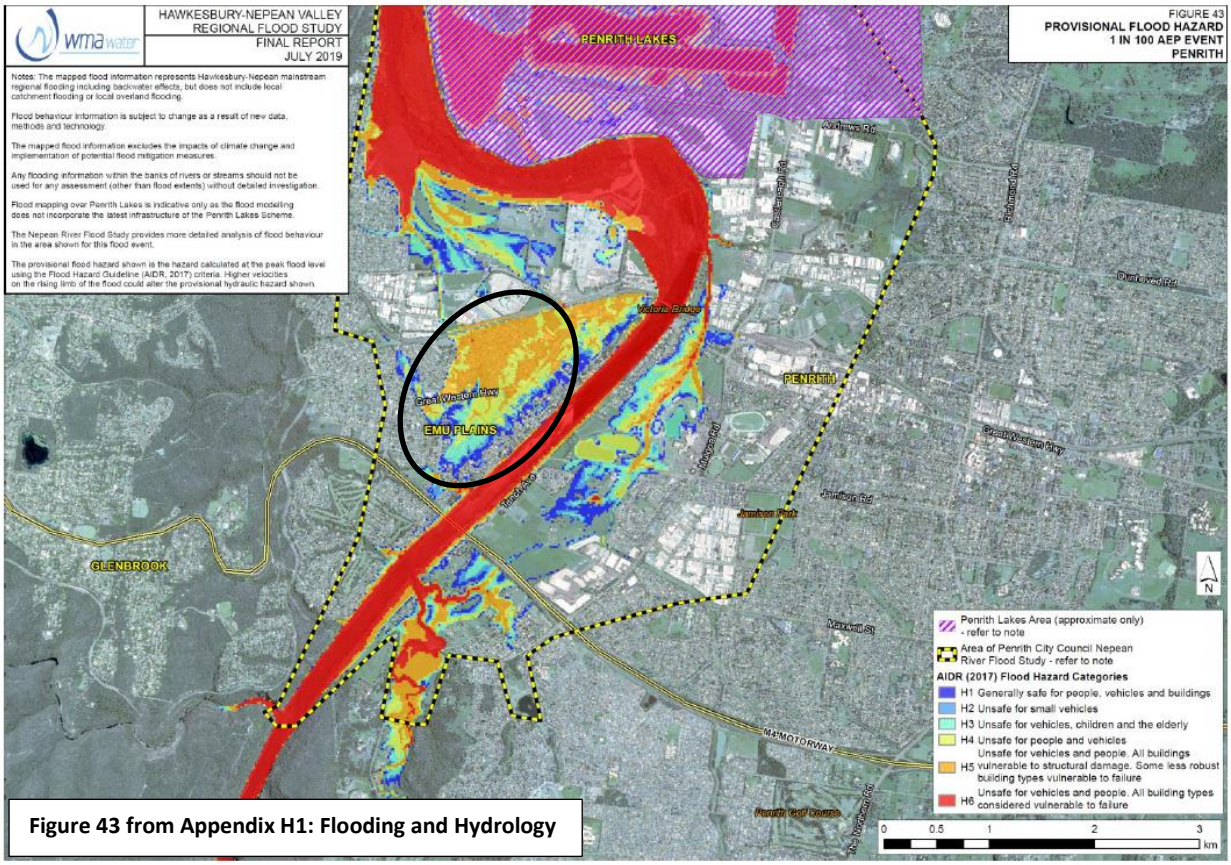


Figure 43 from Appendix H1: Flooding and Hydrology

Figure 3-32 Existing 1% AEP flood hazard mapping – Penrith (Source WMAWater 2019)

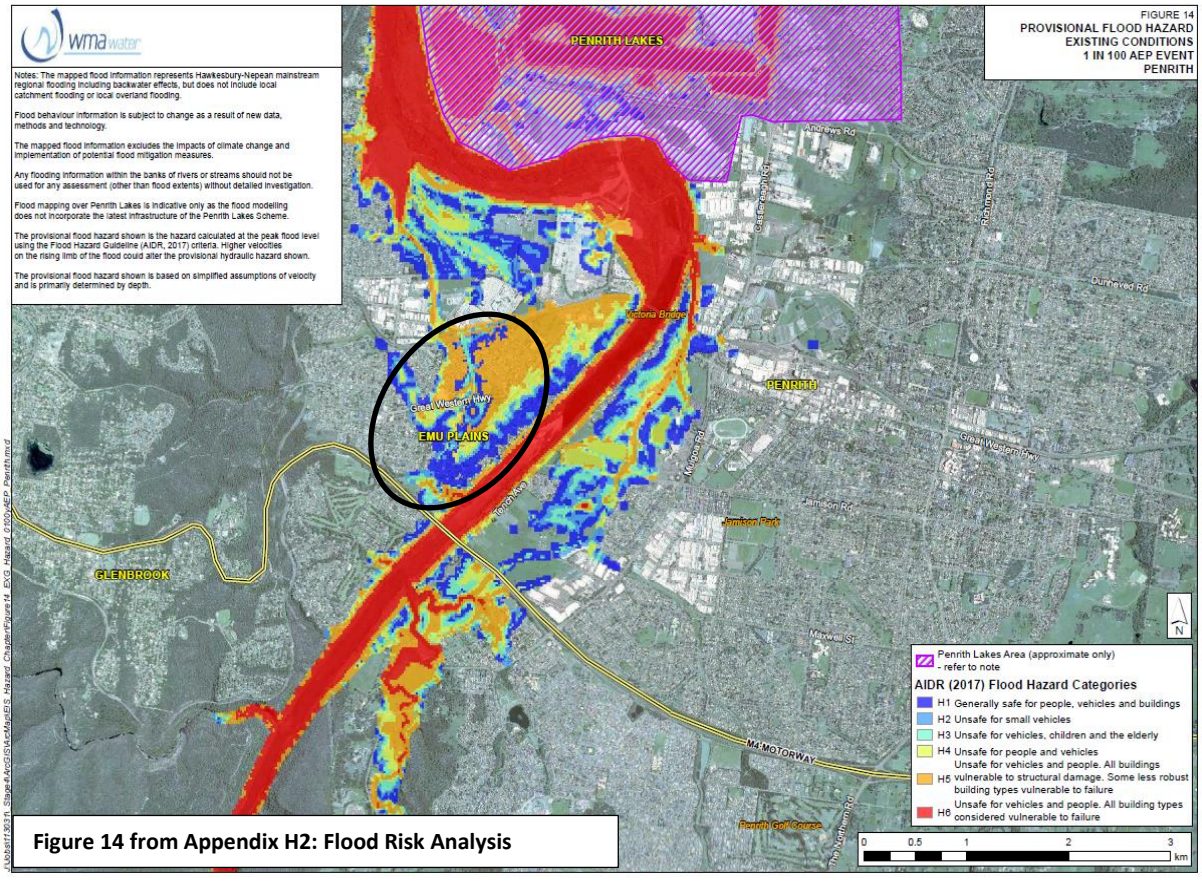


Figure 14 from Appendix H2: Flood Risk Analysis

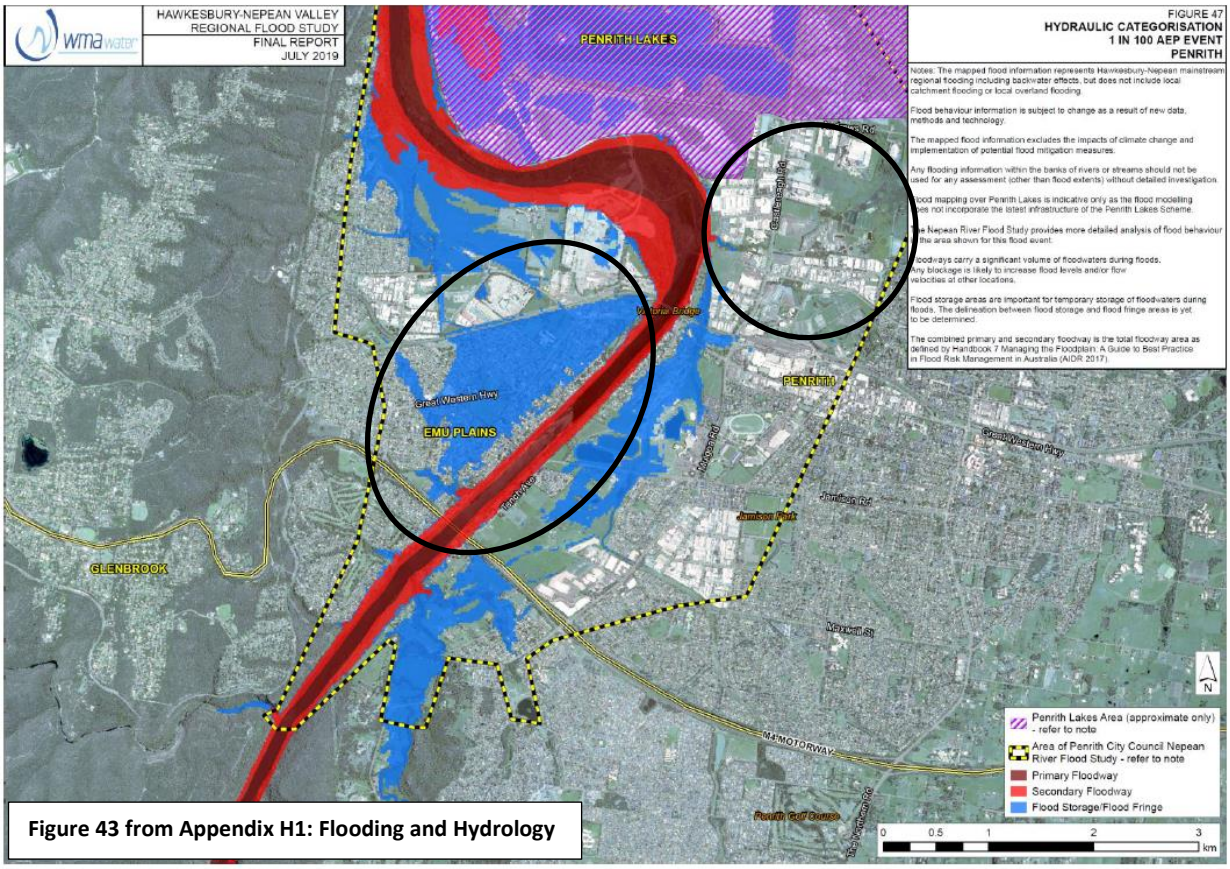


Figure 43 from Appendix H1: Flooding and Hydrology

Figure 3-35 Existing 1% AEP flood function mapping – Penrith (Source WMAWater, 2019)

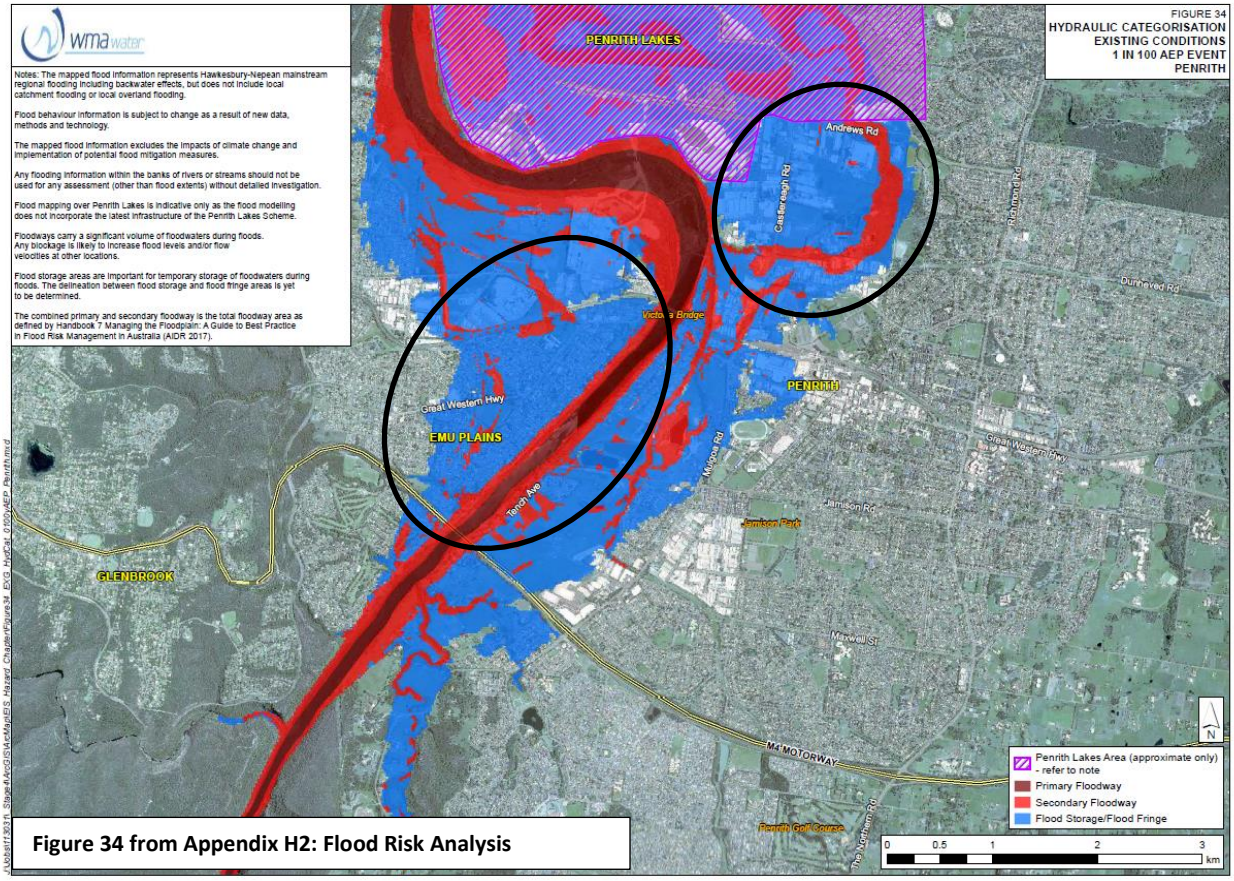
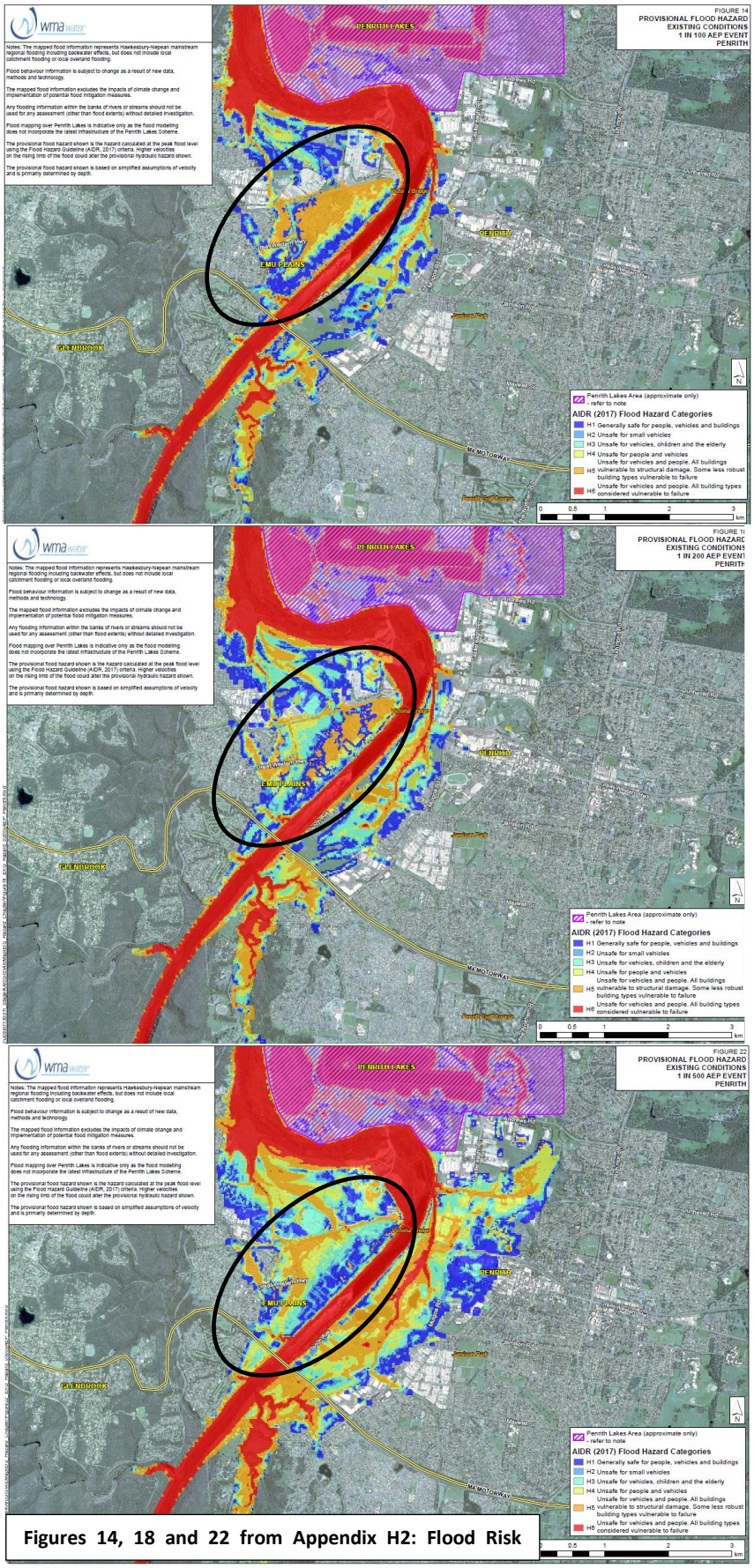


Figure 34 from Appendix H2: Flood Risk Analysis



Figures 14, 18 and 22 from Appendix H2: Flood Risk

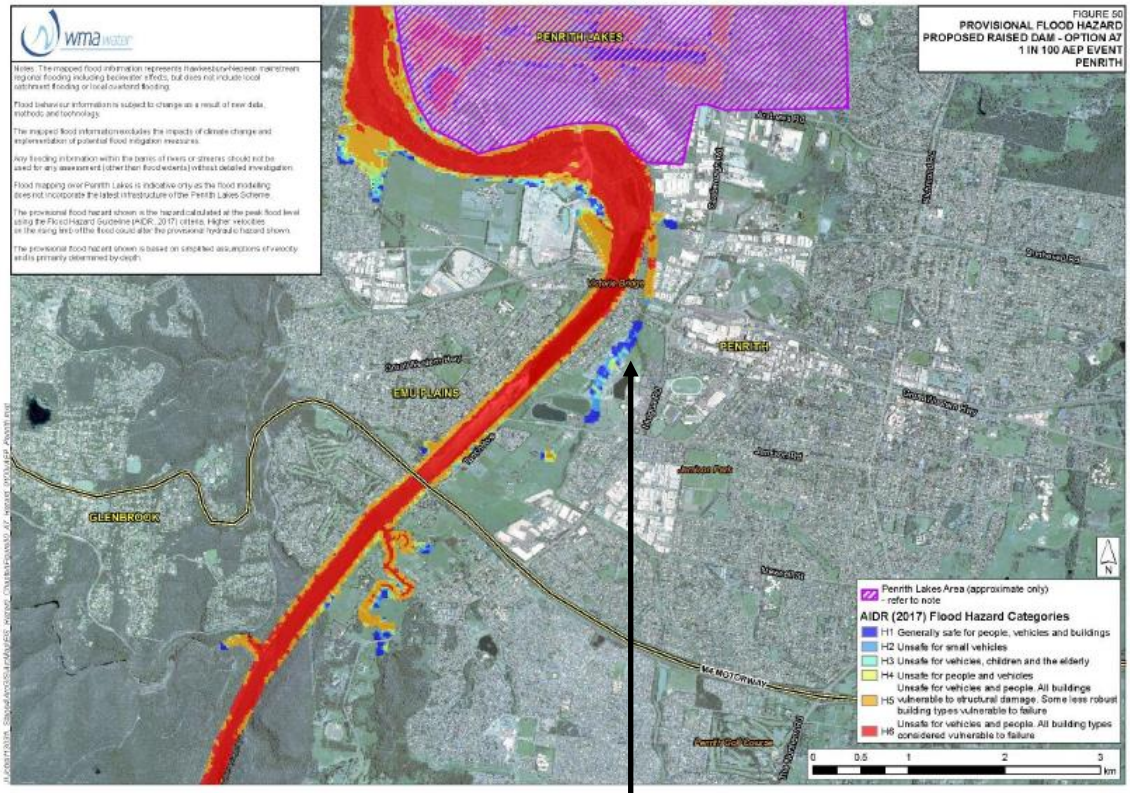


Figure 4-37 Raised Dam 1% AEP flood hazard mapping – Penrith (Source WMAWater 2020)

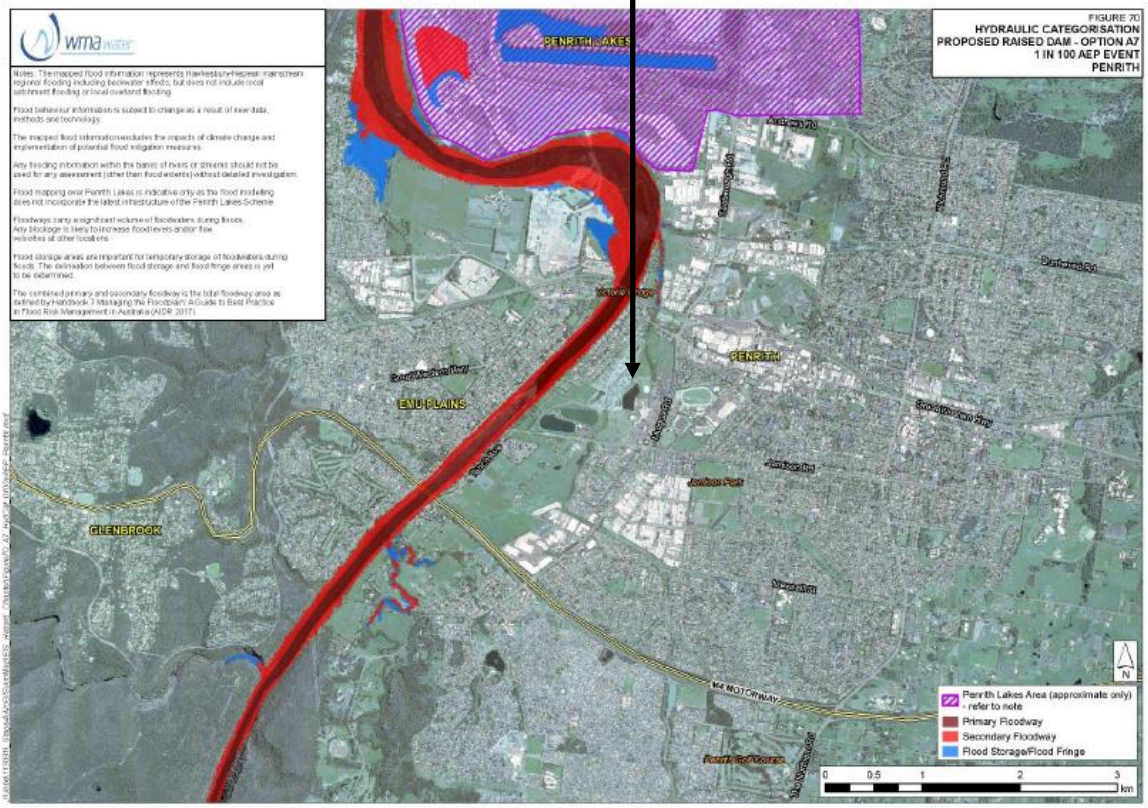


Figure 4-40 Raised Dam 1% AEP flood function mapping – Penrith (Source WMAWater, 2020)

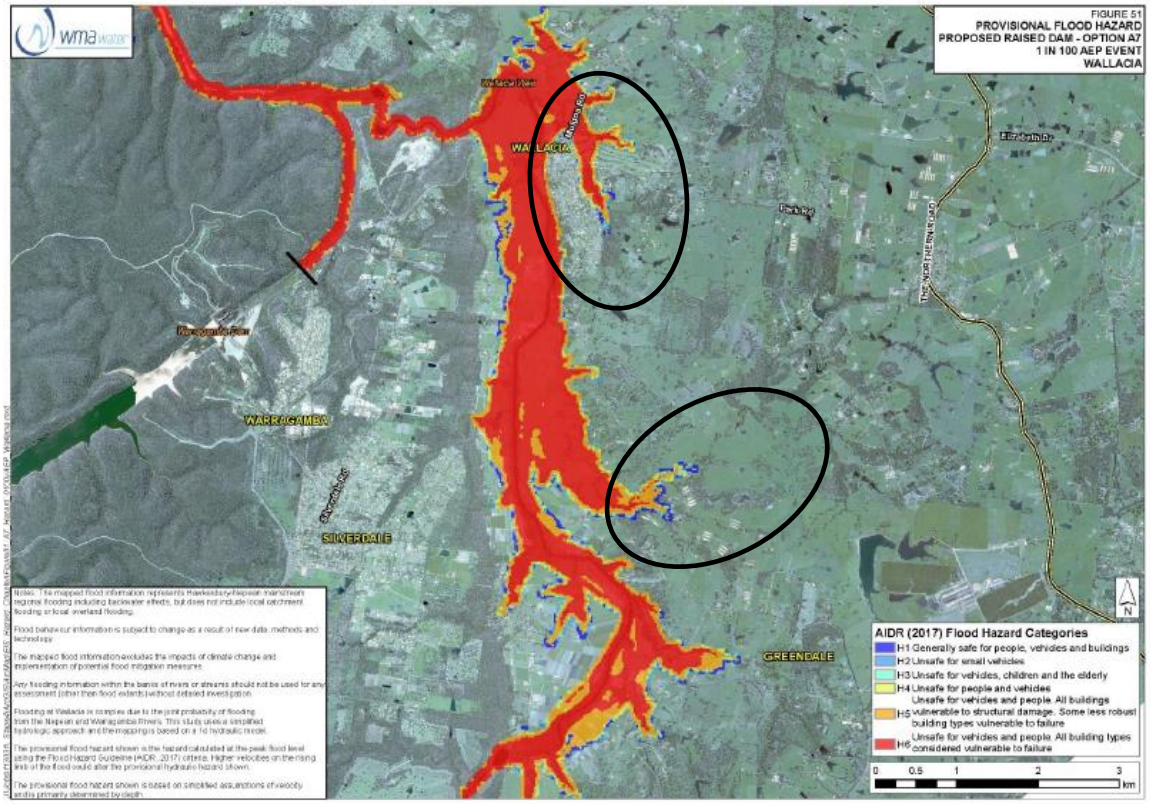


Figure 4-36 Raised Dam 1% AEP flood hazard mapping – Wallacia (Source WMAWater 2020)

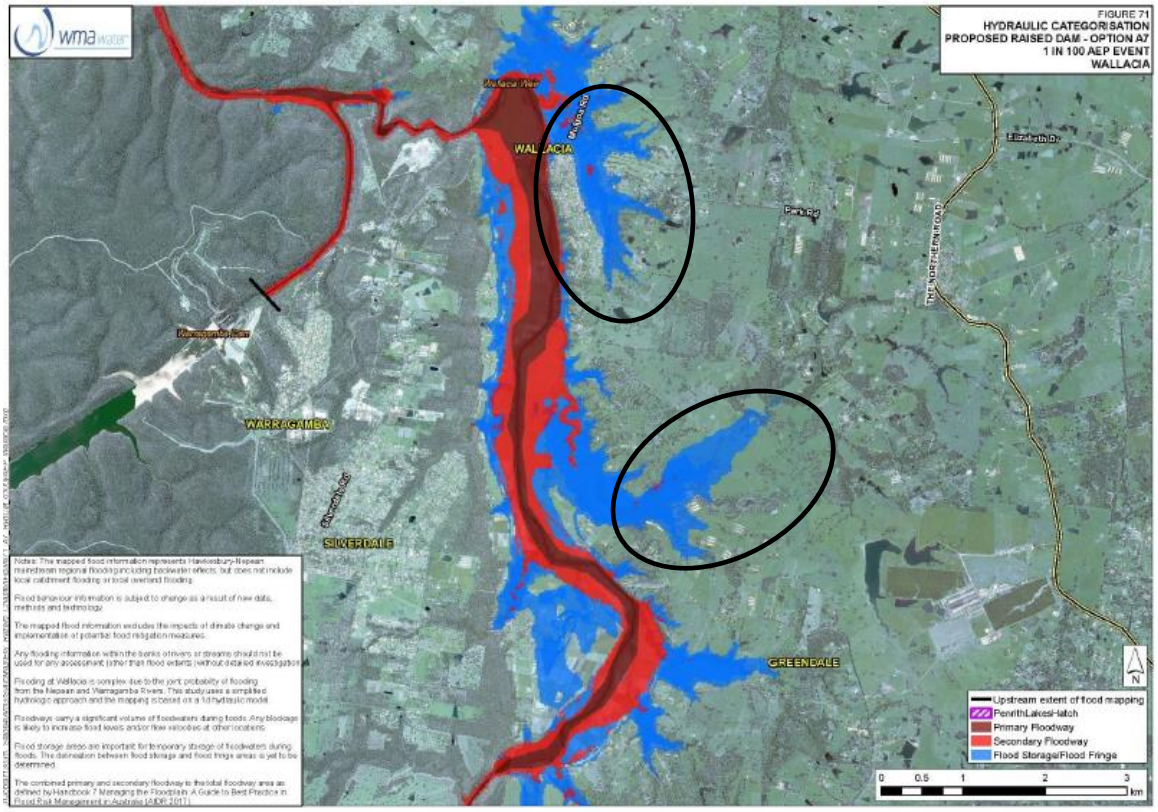


Figure 4-39 Raised Dam 1% AEP flood function mapping – Wallacia (Source WMAWater 2020)

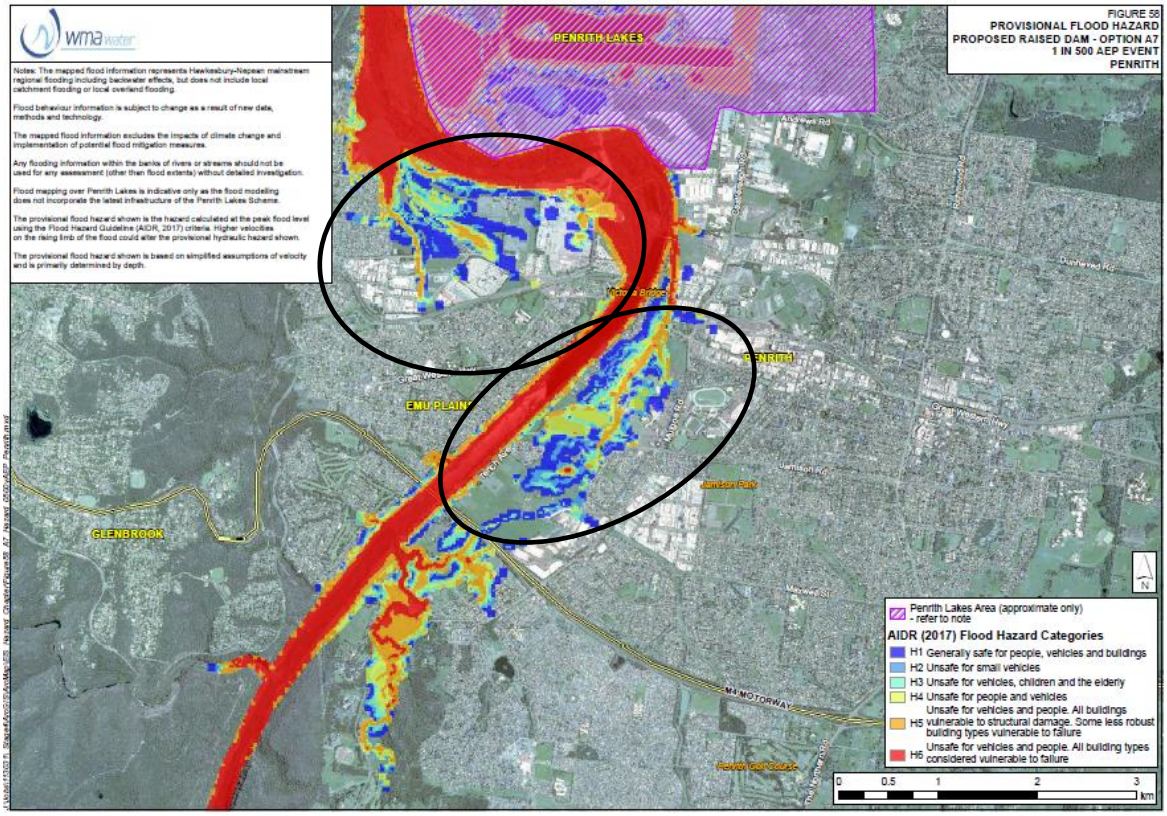


FIGURE 58
PROVISIONAL FLOOD HAZARD
PROPOSED RAISED DAM - OPTION A7
1 IN 500 AEP EVENT
PENRITH
Notes: The mapped flood information represents Hawkesbury-Nepean mainstream regional flooding including backwater effects, but does not include local catchment flooding or local overland flooding.
Flood behaviour information is subject to change as a result of new data, methods and technology.
The mapped flood information excludes the impacts of climate change and implementation of potential flood mitigation measures.
Any flooding information within the banks of rivers or streams should not be used for any assessment (other than flood extents) without detailed investigation.
Flood mapping over Penrith Lakes is indicative only as the flood modelling does not incorporate the latest infrastructure of the Penrith Lakes Scheme.
The provisional flood hazard shown is the hazard calculated at the peak flood level using the Flood Hazard Guideline (AIDR, 2017) criteria. Higher velocities on the rising limb of the flood could alter the provisional hydraulic hazard shown.
The provisional flood hazard shown is based on simplified assumptions of velocity and is primarily determined by depth.
PENRITH LAKES
PENRITH
EMU PLAINS
GLENBROOK
M4 MOTORWAY
Penrith Lakes Area (approximate only) - refer to note
AIDR (2017) Flood Hazard Categories
H1 Generally safe for people, vehicles and buildings
H2 Unsafe for small vehicles
H3 Unsafe for vehicles, children and the elderly
H4 Unsafe for people and vehicles
H5 Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure
H6 Unsafe for vehicles and people. All building types considered vulnerable to failure
0 0.5 1 2 3 km

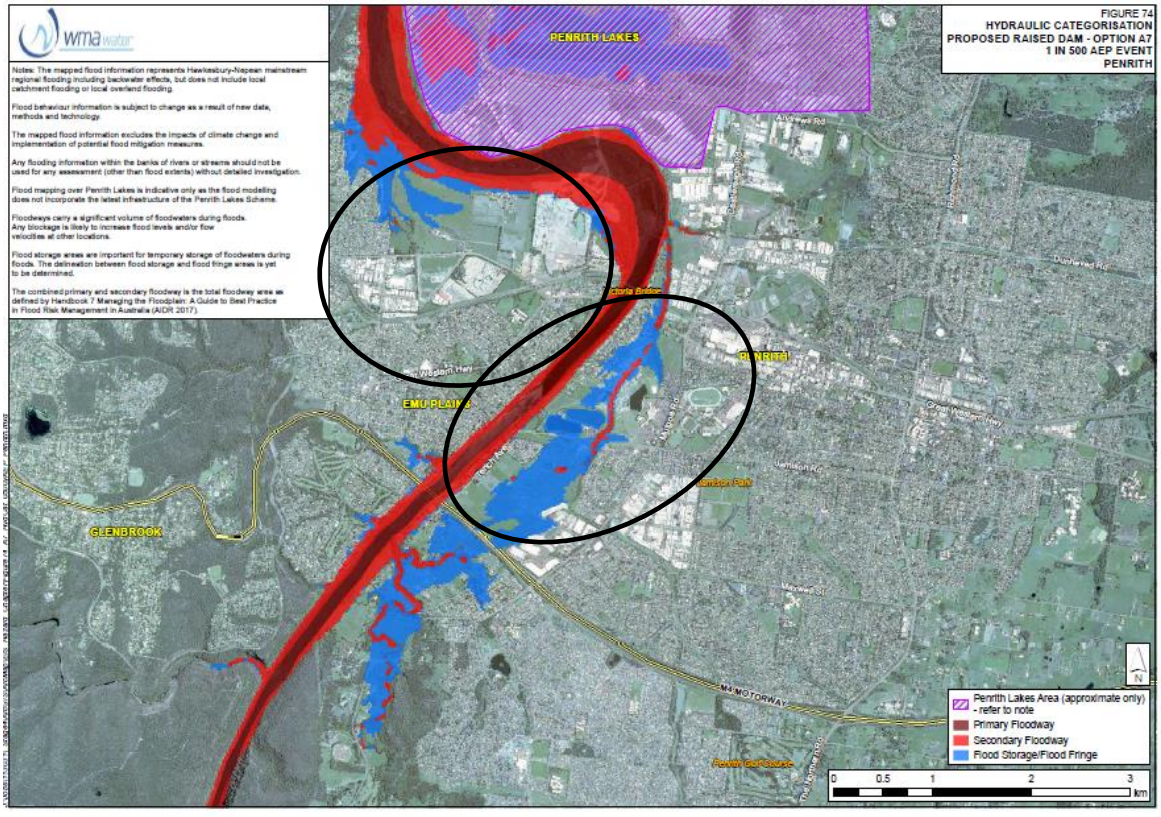


FIGURE 74
HYDRAULIC CATEGORISATION
PROPOSED RAISED DAM - OPTION A7
1 IN 500 AEP EVENT
PENRITH
Notes: The mapped flood information represents Hawkesbury-Nepean mainstream regional flooding including backwater effects, but does not include local catchment flooding or local overland flooding.
Flood behaviour information is subject to change as a result of new data, methods and technology.
The mapped flood information excludes the impacts of climate change and implementation of potential flood mitigation measures.
Any flooding information within the banks of rivers or streams should not be used for any assessment (other than flood extents) without detailed investigation.
Flood mapping over Penrith Lakes is indicative only as the flood modelling does not incorporate the latest infrastructure of the Penrith Lakes Scheme.
Floodways carry a significant volume of floodwaters during floods. Any blockage is likely to increase flood levels and/or flow velocities at other locations.
Flood storage areas are important for temporary storage of floodwaters during floods. The delineation between flood storage and flood fringe areas is yet to be determined.
The combined primary and secondary floodway is the total floodway area as defined by Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR 2017).
PENRITH LAKES
PENRITH
EMU PLAINS
GLENBROOK
M4 MOTORWAY
Penrith Lakes Area (approximate only) - refer to note
Primary Floodway
Secondary Floodway
Flood Storage/Flood Fringe
0 0.5 1 2 3 km

4.5 Evacuation Review

This section provides details of the review of the impacts to flood evacuation.

The Hawksbury Nepean Flood Plan, 2020 prepared by the NSW SES is a sub plan of the State Emergency Management Plan and covers prevention and preparedness measures, the conduct of flood operations and the transition to recovery for floods in the Hawkesbury-Nepean Valley. This plan clearly identifies the methodology of evacuation planning within the Hawkesbury-Nepean Valley.

The areas covered by this plan include:

- Parts of the Wollondilly and Liverpool Local Government areas, downstream from the southern end of Bents Basin near Wallacia, in the NSW SES Sydney Southern Region.
- Parts of the Penrith, Hawkesbury, The Hills and Blacktown Local Government areas in the NSW SES Sydney Western Region.
- Parts of the Hornsby and Gosford Local Government areas, downstream from Wisemans Ferry to Spencer in the NSW SES Sydney Northern Region.

With regards to evacuation in the Hawksbury Nepean Flood Plan, one of the major concerns for Penrith City Council is that SES evacuation routing relies heavily on roads within the Penrith LGA. These roads service evacuees from the Windsor and Richmond regions and as a result, congestion is expected during evacuation of major flood events. Furthermore, these roads also cut off when a certain flood level is reached.

The roads include:

- Castlereagh Road – closes at 20.2m AHD
- The Northern Road – closes at 18.1m AHD
- Londonderry Road – closes at 18m AHD
- Llandilo Road – closes at 23.8m AHD

Section 15.7.3 of Chapter 15: Flooding and hydrology of the Environmental Impact Statement covers changes in evacuation planning. This section covers the changes that are required to the revised evacuation plan, we believe that some further information should be provided as part of the EIS to better understand the true impact of the dam raising. It can be understood from this section of the document that data from initial revised evacuation modelling amongst other components of the Flood Strategy has been used to comment on benefits of the dam raising. However, our review the EIS with consideration to evacuation planning, it is difficult to understand the severity of impacts with the level of detail provided within the EIS.

It is clearly understood that the attenuation of flows by the FMZ during major flooding events will reduce the peak levels downstream of the dam. However, there is a negative impact of prolongation of flooding within low lying areas. There is a shortcoming of data related to this that makes it difficult to truly understand the impact this will have on emergency evacuation.

Review Comments

In Appendix H1, the change in peak flood extent map for the 1% flood event is not provided. We believe that this is an error in the document as the 20% AEP map is provided twice and then the extreme flood event map. The 20% AEP map shows a very positive reduction in flood extents, particularly downstream of the Penrith LGA, which should theoretically ease evacuation congestion along its roads.

In table 15-10 of Chapter 15 the number of people requiring evacuation is outlined. It would be ideal if the report could also comment on the number of residents that would no longer need to be evacuated after the dam has been raised. This comparison data between existing and raised dam conditions will give a better view of the reduction of people who are within

flood evacuation zones. With this data, Penrith City Council will also gain a better understanding of the reduction to road congestion during evacuation to roads within our LGA.

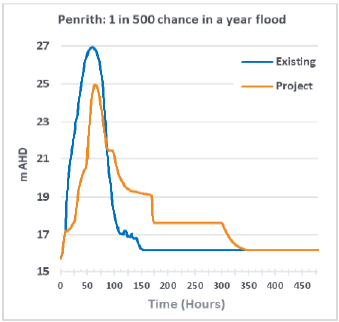
Currently, the only data available in the report is the number of people no longer affected by flooding, as shown in in table 15-28, and does not take into evacuation into consideration.

Table 15-10. Number of people requiring evacuation (2018)

Flood size 1 in X chance in a year	Residents Existing risk (2018)					Employees Existing risk (2018)			Total people considered in evacuation planning (2018)
	Residents in dwellings in flooded areas (2018)	Residents in manufactured homes in flooded areas (2018)	Total residents in flooded areas (2018)	Residents in isolated dwellings (2018)	Total residents considered in evacuation planning	Employees who work in flooded areas but live outside the floodplain	Employees isolated on High Flood Islands who live outside the floodplain	Total employees considered in evacuation planning who live outside floodplain	
100	15,800	3,900	19,800	23,400	43,100	9,600	2,200	11,900	55,000
500	34,900	4,000	39,000	22,200	61,200	23,700	2,900	26,600	88,000
PMF	86,900	4,200	91,000	12,900	104,000	48,100	300	48,400	152,000

Prolongation of flooding can be argued as the biggest negative impact downstream due to the dam raising and FMZ release of water. Table 15-29 covers the potential impacts of the prolonged 100 gigalitres per day discharge rate. It is seen that the floodplain road network is not affected apart from two bridges over Cattai Creek. It would be ideal if modelling data is released to substantiate this. Without this data it is difficult to understand what the prolonged impact can have at road cut off points. For example, Rickabys creek backwater flooding causes Londonderry Road to have its road cut at 18m AHD during severe storm events. Table 15-21 shows that the 1 in 500 chance in a year flood having an elongated period of approximately 7 days of flood levels above 19m AHD. If another storm even occurs during this then there is a possibility that residents can be cut off from their properties for days or even a week. Furthermore, if prolonged flooding occurs over cut roadways, the SES will need to have revised community awareness strategies for prolonged flooding which will be a negative social impact. Therefore, this increase in low level flooding and subsequent impacts needs to be further discussed and explained through modelling results.

1 in 500 chance in a year



The Project would substantially reduce flood extents in Emu Plains Heights while only a minor reduction of flooding extents would occur in Emu Plains. The Project would prevent substantial areas of flooding in the Penrith town centre and Jamisontown.

A positive point with the dam raising is the increase in time to road closure. This increase is positive almost across the board except for the PMF event at Cattai Creek Road Bridge as shown below in Table 15-26 (below). There is a reduction of 3 hours compared to the existing conditions. The reason for this is not clear in the report and we believe this anomaly should be explained in conjunction with this table.

Table 15-26. Number of hours before a river crossing is closed for existing conditions and with the Project

Location	Hours before a river crossing is closed for different flood events Red shading = increase in time to closure; Green shading = decrease in time to closure									
	1 in 5 chance in a year (hours to closure)		1 in 10 chance in a year (hours to closure)		1 in 20 chance in a year (hours to closure)		1 in 100 chance in a year (hours to closure)		PMF (hours to closure)	
	Existing	Project	Existing	Project	Existing	Project	Existing	Project	Existing	Project
Cattai Creek Road Bridge	8 (3-22)	10 (4-23)	8 (2-14)	8 (3-19)	6 (2-13)	7 (3-17)	5 (2-11)	6 (3-14)	6	3
Yarramundi Road Bridge	3 (1-17)	6 (3-21)	3 (1-9)	5 (3-17)	2 (1-5)	4 (2-14)	2 (1-4)	4 (2-10)	1	3
Windsor Road Bridge (New)	Not closed	Not closed	Not closed	Not closed	30 (21-45)	Not closed	21 (15-34)	39 (29-54)	8	14
North Richmond Road Bridge	4 (3-17)	17 (6-27)	5 (3-19)	11 (5-22)	3 (2-12)	9 (4-20)	3 (2-10)	6 (4-19)	2	5
Richmond - Blacktown Road Bridge	Not closed	Not closed	Not closed	Not closed	46 (35-64)	Not closed	38 (26-55)	59 (43-75)	20	28
Jim Anderson Bridge	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	29 (21-41)	Not closed	18	24
Victoria Road Bridge	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	53	64
M4 Motorway Bridge - Nepean River (west)	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed
M4 Motorway Bridge - Nepean River (east)	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	81	110
M4 Motorway - South Creek	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	69	93
Great Western Highway - South Creek	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	7	8
Blaxland Crossing Road Bridge (Wallacia)	15 (11-29)	15 (12-29)	12 (8-26)	13 (9-26)	10 (5-19)	11 (8-20)	8 (3-15)	10 (7-18)	7	8

Note: Range is 10th to 90th percentile. Hours to closure indicated in brackets

Chapter 21: Socio-Economic, land use and property sets to provide a comprehensive study on the socio-economic impacts to the communities potentially affected by the dam raising. Table 21-23 below shows the summary of impacts to the downstream communities. It is agreeable from the EIS that the impact nature will most likely be positive. However, empirical data would better support it for the purposes of validation.

Table 21-23. Summary of impacts – the downstream communities' study area

Impact description	Impact nature	Residual significance rating
Operation - Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Liverpool	Positive	Extreme
Operation - Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Penrith	Positive	Extreme
Operation - Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Blacktown	Positive	Extreme
Operation - Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of Hawkesbury	Positive	Extreme
Operation - Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation) in the LGA of The Hills	Positive	Extreme
Enhanced safety of residential areas due to reduced extent and frequency of floods, including reduced risk of post-flooding infectious disease	Positive	Extreme
Enhanced safety due to improved ability to evacuate communities	Positive	Extreme
Reduced risk to people living in highly vulnerable forms of housing	Positive	Extreme

Table 15-11 shows the flooding classification and evacuation characterised by area. It is our opinion that a discussion about changes (i.e., existing vs. dam raising) to low and high flood islands should be written in the EIS so that there is a better understand the impacts to low and high flood islands within the Penrith Local Government Area with the raised dam.

Table 15-12 shows the relevant flood studies and floodplain risk management strategies for the EIS. This list, however, does not include the Penrith CBD Floodplain Risk Management Study 2020. Section 8.4.1 of this Flood Risk Management Study discusses regional evacuation routes and should be considered for the EIS as well as evacuation planning.

In conclusion, the EIS shows that the Dam raising impacts evacuation in a positive way. The most positive impact for evacuation that is observable is the increase of time gained before bridges and roads close in evacuation routes. This will result in much longer times for evacuations to take place. Furthermore, the attenuation of water by the FMZ has positive affectation on flood extents in the floodplains with large reduction in flood extents downstream of Penrith LGA, particularly in the Richmond and Windsor areas through many of the design storm events. There are several arterial evacuation routes from the Richmond and Windsor sectors that funnel evacuees south through the Penrith LGA, a reduction in flood extents will reduce the number of residents utilising the routes and therefore reduce congestion during this time. This has a compounding positive effect to flood evacuation with the increase of time allowed before roads and bridges are cut off.

However, further information would be required for gain a better understanding of the impacts of the dam raising. This would include:

- Flood modelling data to support positive impacts
- the 1% AEP Change in Peak Flood Extent Map
- Data showing the reduction of people requiring evacuation with dam raising
- Data related to road and bridge cut of areas during prolongation of low-level flooding due to FMZ
- Explanation for reduction in time to cut off at Cattai Creek Road Bridge
- Differences to low and high flood islands identified in report when dam is raised
- Inclusion of the Penrith CBD Floodplain Risk Management Study and Plan 2020

5. Planning Considerations

- Council would need to have a policy/strategy of how the new flood risk is to be incorporated in the Council planning post the dam upgrade.
- Dam upgrade would reduce flood risk. How does Council update its flood studies and floodplain risk management plans?
    - Council will need to review and update all its relevant flood studies and floodplain risk management plans. Funding from State Government would be required to review and update its studies.
    - Flood models and data from State Government would be required to update Council's studies.
- The EIS states that the flood mitigation capacity of the dam would decrease with time due to climate change (Chapter 5, Pg5-1). If Council revises the flood risk management plans based on the current flood mitigation capacity of the raised dam, those FRMPs would need a constant revision to ensure that the reduced mitigation capacity is considered.
- SEARs require mapping of Flood Planning Area (Chapter 15, page 15-3) for the new design flood under the Project. This has not been provided.
- A statutory requirement that the downstream floodplain development is not intensified to make use of the reduced flood risk due to Warragamba Dam Raising. This is important because climate change would reduce the dam's risk mitigation capacity and the risk of dam failure would increase, which would require a higher standard of dam maintenance

- How the revised risk of modified dam is to be conveyed to the community.
- Does Council need to start updating the flood study well before the wall raising project is completed, so that a new flood study is ready and the new flood planning areas are established and ready to be utilised for development planning and controls
- Statutory requirement to impose restriction on use of Flood Mitigation Zone of the dam for water supply or any other purposes.