ITEM 10 – VICTORIAN FLOOD EVENTS – UNDERSTANDING IMPLICATIONS FOR VPA PLANNING

Purpose

Brief the Board on the impacts of recent and ongoing flood events across Victoria and any implications for the VPA's past and future planning projects.

Recommendation

That the Board notes the advice on:

a) The impact of flooding events on recently completed and planned metropolitan Melbourne and Regional Victoria Precinct Structure Plans
b) The implications for the VPA's future PSP Program, in both metropolitan and regional Victoria
c) That Appendix 1 in the ***Resource Centre*** provides detailed background on how the VPA plans for flooding.

Strategic Plan Alignment

This matter relates to Pillars 1, 2 and 3 of the VPA's Strategic Plan, as it pertains to the VPA's role as urban growth planner, trusted problem solver and expert advisor.

Summary of the VPA's approach to flood planning

This section provides a brief summary of the methodology and mechanisms the VPA utilises when planning for water related infrastructure in PSPs, with further detail provided in Appendix 1.

In our structure planning projects for new communities to accommodate ongoing population growth, urban development, and urban consolidation, the VPA needs to consider and plan for potential flood risks and avoid exposing people and property to flooding events.

In order to adequately plan, manage and mitigate flood risk in PSPs, the VPA relies heavily on Victorian State Government planning benchmarks and policy objectives set by the Department of Transport and Planning (DTP) and supported by *the Planning and Environment Act (1987)*, as well as specific technical modelling and data prepared by relevant water authorities. The VPA translates these more strategic, state-wide frameworks into specific, place-based approaches to flood assessment and mitigation at the localised PSP level. To ensure we are adopting the latest information and standards across each different land use planning setting, we seek advice and guidance from Department of Energy, Environment and Climate Action (DEECA), formerly DELWP, Melbourne Water (MW), the relevant Catchment Management Authority (CMA), and relevant local councils.

In summary, the VPA is responsible for appropriately planning for flood overland flows and limiting flood risk to an acceptable community standard at the PSP level. While the VPA recognises the importance of imposing higher flood standards in anticipation of intensifying climate change, the VPA is ultimately guided by the requirements set out in existing state policy frameworks.

Performance of VPA PSPs during 2022 Victorian Floods

The VPA has undertaken a high-level assessment of planning project areas across all development contexts and how these performed during the recent 2022 flood events in Victoria.

Metropolitan Melbourne – Urban Renewal

In urban renewal areas in Melbourne, the VPA, in consultation with Melbourne Water, undertakes extensive work to model flooding and prepare drainage solutions to manage flooding and drainage and enable development.

There were no flooding impacts in any of the areas the VPA has undertaken planning for, including:

- Arden
- Arden Macaulay
- Altona North Precinct 15
- Bentleigh East
- Clayton Business Park.

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Metropolitan Melbourne - Greenfields

Metropolitan Melbourne's greenfield areas experienced limited riverine flooding with the notable exception of the Maribyrnong River. The Northern Growth Corridor (NGC) was the main growth corridor impacted by the floods, with no reported flood impacts in either the Western or South East Growth Corridors. In Mitchell Shire particularly, swamp areas such as Hanna and Hearns Swamps in Wallan appear to have been affected by the wet weather conditions in preceding months. While this caused soil water logging and resulted in greater surface water retention during the 2022 flooding events, this retention rate was still in line with planned forecasts.

Satellite images for both Wallan South and Wallan East PSPs, ***(Attachment 1),*** show the flooding extent in January and October 2022, with the third element of the image showing the modeled 1% AEP predicted flood extent. These satellite imagines, combined with on-ground information, indicate no impact on current or completed PSPs, specifically no flooding on PSPs outside of known ephemeral wetlands such Hanna and Herne swamps. Consistent with the observed flooding extent in completed or under preparation regional PSPs, flooding has occurred as provided for in greenfield PSPs.

It should be noted that when analysing the effects of flooding, the VPA only has access to satellite image data, which purely demonstrates the geographical extent of flooding. Additional information such as flood water depth and velocity of water, which is predicted using flood modelling software during formal flood PSP assessment stage is required to understand the full extent of flooding impact in a particular context.

Due to the higher than anticipated flooding impacting Maribyrnong River, Melbourne Water have announced an independent review of the Maribyrnong River flood to be led by Nick Wimbush. The Terms of Reference (ToR) for the review will focus on issues related to impacts stemming from the Flemington Racecourse Flood Wall, and do not extend to any review of land use planning or planning scheme controls.

The VPA is not currently undertaking any planning projects within the Maribyrnong River Catchment. However, should the VPA be further engaged to undertake planning for Defence Site Maribyrnong (DSM), any recommendations stemming from the Maribyrnong River flood review and the impacts of the 2022 floods would need to be considered.

Overall, Melbourne Water advised the VPA that in Metropolitan Melbourne, specifically the greenfield areas, existing flood mitigation measures performed as intended with no major flooding or concerns raised.

Regional Victoria

In comparison to metropolitan Melbourne, flooding impacts in regional Victoria as a result of the 2022 floods were extensive, with some towns experiencing the highest river peaks in several decades.

More specifically, Shepparton and Echuca experienced significant floods, however, neither Echuca West (completed August 2022), the Shepparton South East (still under preparation), nor the Shepparton North East (completed October 2019) Precinct Structure Plans (PSP) areas were significantly impacted. Satellite images at ***(Attachments 2*** and ***Attachments 3)*** show the PSP boundaries and the flooding extent. As with the two Wallan PSPs, these satellite images show the flooding extent in January and October 2022, with the third image showing the modelled 1% AEP predicted flood extent.

In order to determine the impact of recent flooding events on both completed PSPs or planned PSPs, the VPA drew upon satellite images and on the ground information from the relevant local council. Table 1 below details regional Victoria projects, both recently completed or currently under preparation (i.e.) Bendigo Regional Employment Precinct (BREP) and Greater Avalon Employment (GAEP), and the flood impacts on these projects.

Planning for these projects will be undertaken using information from recent flooding as part of the flooding and drainage assessments for these projects. Further, these projects will require detailed flood assessment and inclusion of drainage and flood mitigation works into any Developer Contribution Plan (DCP).

It is important to note that for projects in regional cities and towns, the VPA typically acts either as 'planning authority' or 'planning provider'. The planning authority role includes a mandate to lead the project and deliver the outcome (including recommending a planning scheme amendment to the Minister), while the planning provider role describes a mandate to the prepare a plan or other report to provide to the relevant planning authority to be progressed through the statutory process. These roles are also outlined in Table 1 below.

Table 1: Summary of recent floods impacts in VPA's regional PSPs

Project	Project Type	Location	Status	Impact
Echuca West	PSP#	Campaspe Shire Council	Completed 9 November 2020	Waterway flooding had no impact on the PSP
Shepparton North-East	PSP*	Greater Shepparton City Council	Completed 1 March 2020	Appears unaffected by flooding
Leneva-Baranduda	PSP#	City of Wodonga	Completed 5 April 2019	Digital twin data does not extend to this area
Bannockburn South-West	PSP*	Golden Plains Shire Council	Completed 15 August 2022	Satellite image obscured by clouds, current data indicates that there are localised overland flow paths on this site and no major waterways
Shepparton South-East	PSP*	Greater Shepparton City Council	Under preparation	Waterway flooding was fully contained within the existing Broken Creek "Flood Zone" in the planning scheme
Wonthaggi North-East	PSP*	Bass Coast Shire council	Nearing completion	Digital twin data does not extend to this area
East of Aberline	PSP*	Warrnambool City Council	Under preparation	Appears unaffected by flooding
Bendigo Regional Employment Precinct (BREP)	PSP*	City of Greater Bendigo	Under preparation	Recent flooding will be assessed as part of the planning
Greater Avalon Employment (GAEP)	PSP*	City of Greater Geelong	Under preparation	As above

** Planning Authority*

 # Planning Provider

Implications for future PSP Program, Metropolitan Melbourne and Regional Victoria

Augmentation of current VPA practice

The VPA approach to flooding assessment has been evolving over time in line with the approaches adopted by our key stakeholders, and in accordance with legislation, including the *Planning and Environment Act (1987)*, relevant planning guidelines, and specific planning project needs. The VPA is confident in its approach to planning for flood and will continue its current practice of adapting.

Climate Change and recent rainfall

In relation to climate change and recent rainfall, ***Attachment 4*** contains graphical plots sourced from the Bureau of Meteorology website for:

- Long-term average rainfall across Australia from 1981 to 2010.
- Rainfall across Australia in the 12 months ending 30 November 2020.

This indicates a significantly greater rainfall recently compared to the long-term average, which is consistent with the wetter weather patterns being experienced across Victoria.

There is now widespread acceptance that human activities are contributing to observed climate change. Victoria's climate has changed in recent decades, becoming warmer and drier. To address the risks and coastal impacts associated with climate change, current Victorian State Policy is to plan for sea level rise of 0.8 metres by 2100 and allow for the combined effects of tides, storm surges, coastal processes when accessing risks and coastal impacts associated with climate change (Clause 13.01-2S).

As outlined in Section 4 and Appendix 1, the role of the VPA with regards to flood planning is to translate state-wide planning benchmarks set by the Department of Transport and Planning (DTP) and supported by *the Planning and Environment Act (1987),* into localised approaches to flood assessment and mitigation at the PSP level. While the VPA recognises the importance of imposing higher flood standards in anticipation of

intensifying climate change, the VPA is ultimately guided by the requirements set out in existing state policy frameworks.

The recent Moyne amendment C69 speaks to this feature of Victoria's planning system, highlighting the difficulty planning authorities face in being unable to "choose their own adventure" when it comes to drafting planning controls in anticipation of climate change. Moyne Shire and the Glenelg Hopkins Catchment Management Authority advocated for a higher sea level rise planning benchmark of 1.2 metres over 0.8 metres in an attempt to better respond to global projections and local conditions at Port Fairy.

Even though Council was supported by local conditions and evidence, the Panel concluded that any local flood planning controls must adhere to Victorian state policy planning benchmarks, concluding that the most appropriate measure for sea level rise should be 0.8 metres.

Nonetheless, it will be important for the VPA to be alert to the implications of adapting to climate change over time, including any state-wide, long-term assessments conducted by the Department of Transport and Planning, as well as more specific reviews such as the outcomes of Melbourne Water's Maribyrnong River floods review, and what this will mean for how we plan for flooding in the future. Considering the level of uncertainty posed by intensifying climate change, the Victorian planning system as a whole may need to adopt a more proactive, adaptive, and innovative approach to flood planning that consider a range of climate change scenarios.

Further cross government work

As noted earlier in this report, Melbourne Water have announced an independent review of the Maribyrnong River flood. In addition, both the Department of Energy, Environment and Climate Action (DEECA), and Department of Transport and Planning (DTP) are undertaking additional analysis, including mapping, flood recovery planning and a full range of response to the recent flooding events.

The VPA will need to take on board any recommendations and actions the government may want implemented going forward to mitigate flood risk.

Next steps

The VPA will need to continue to monitor outcomes stemming from any review and or analysis across government of how the State needs to plan for and manage riverine flooding.

It will also be important for the VPA to be alert to the implications of adapting to climate change over time, and particularly how this might overlap with Integrated Water Management (IWM) approaches.

The VPA will continue to collaborate with DEECA, Melbourne Water, respective Catchment Management Authorities, and local councils to not only ensure that VPA PSPs incorporate proposed water savings through IWM measures, but also reflect the most up-to-date data and flood mitigation measures.

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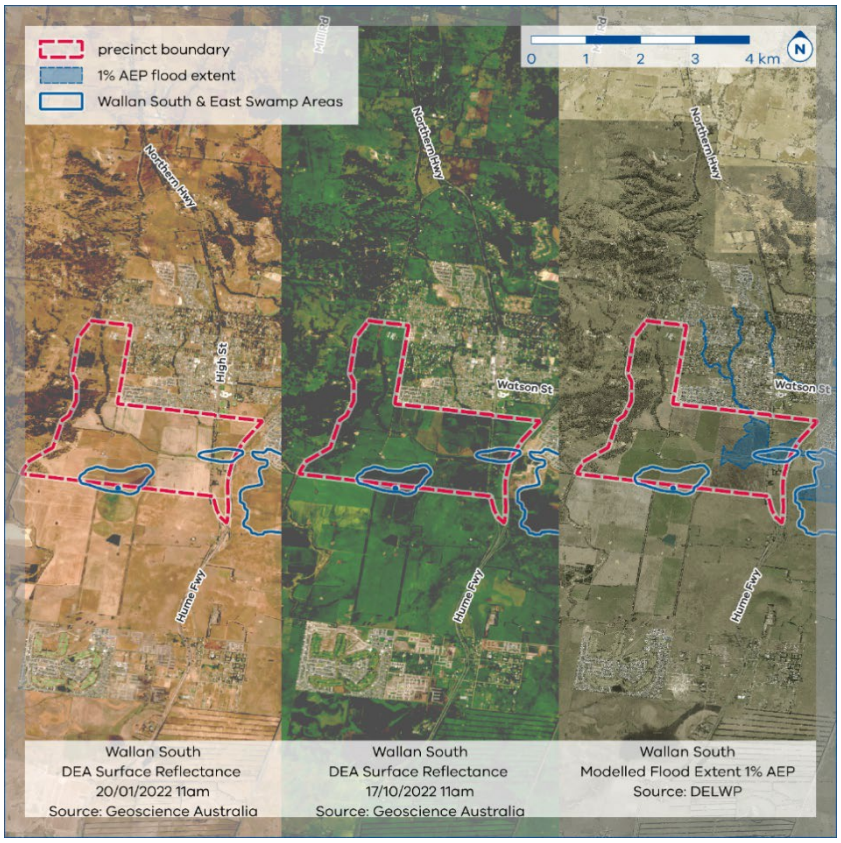
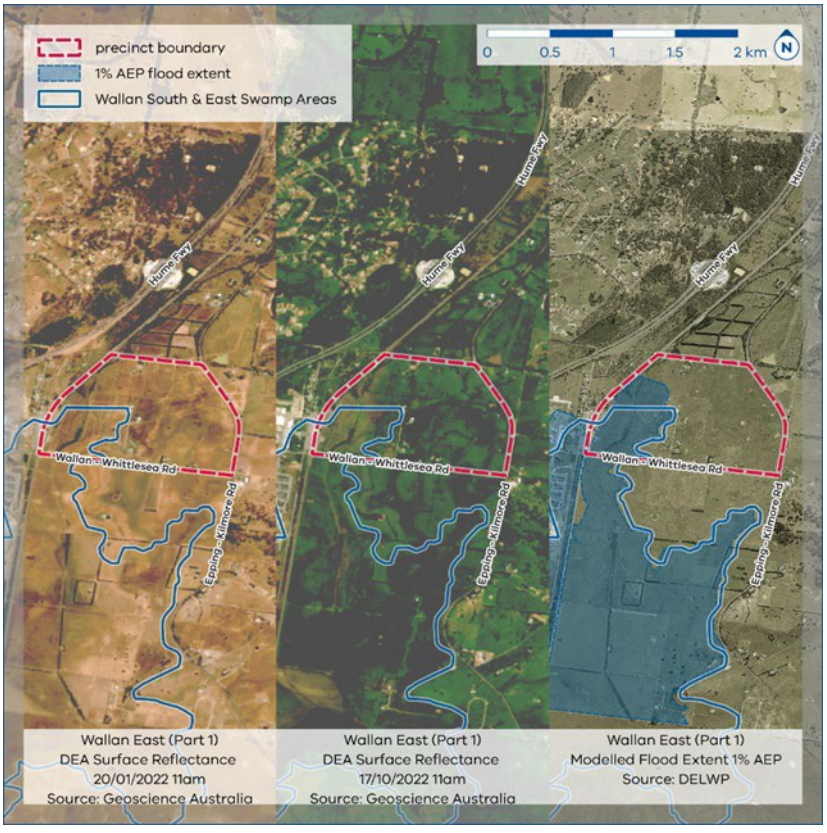
ATTACHMENT 1



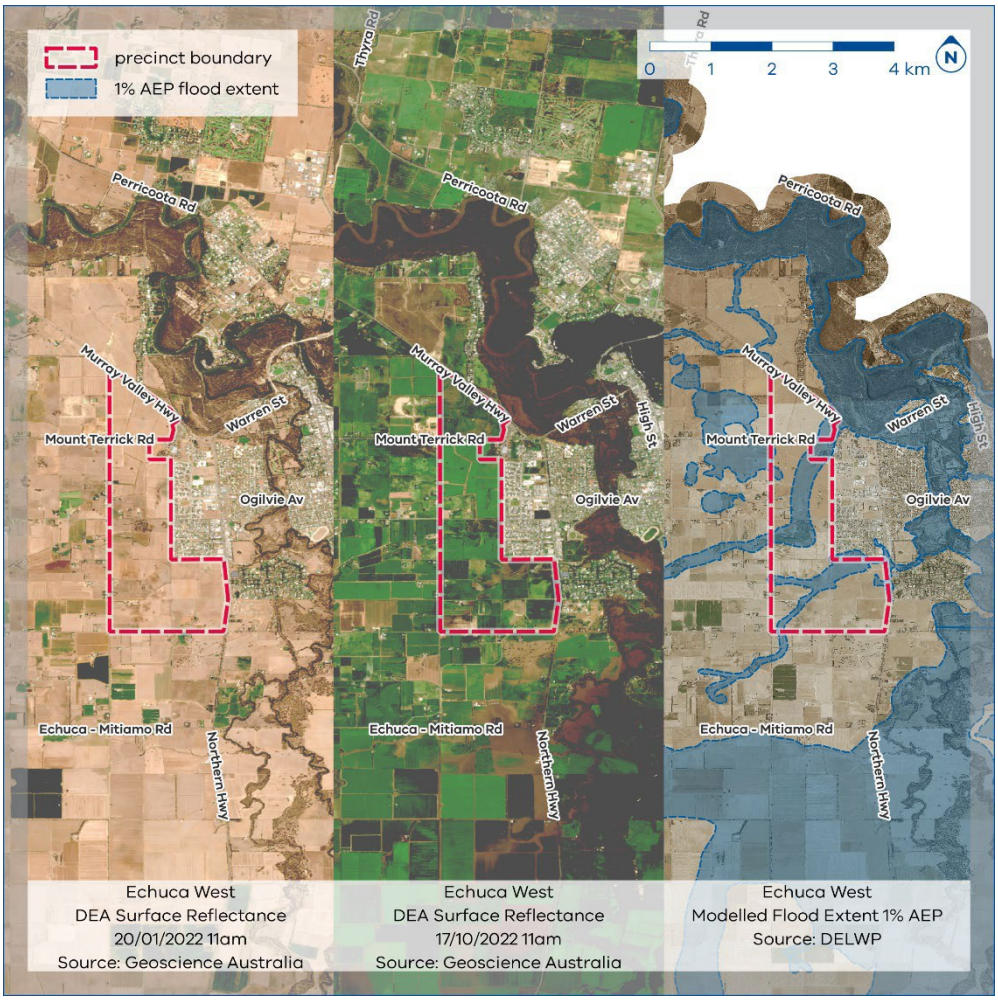
Wallan South PSP

Left and Centre Images show flood extent in January, and October 2022 with the picture at the right showing the modelled 1% AEP flood extent.



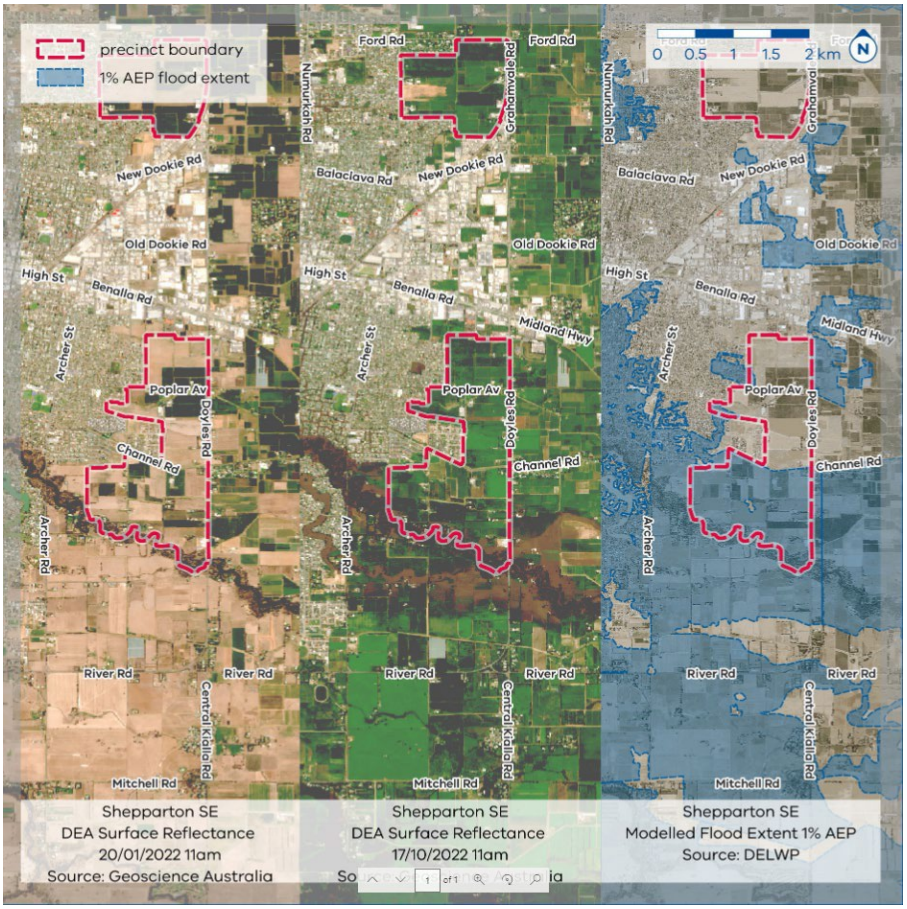
Wallan East PSP

ATTACHMENT 2



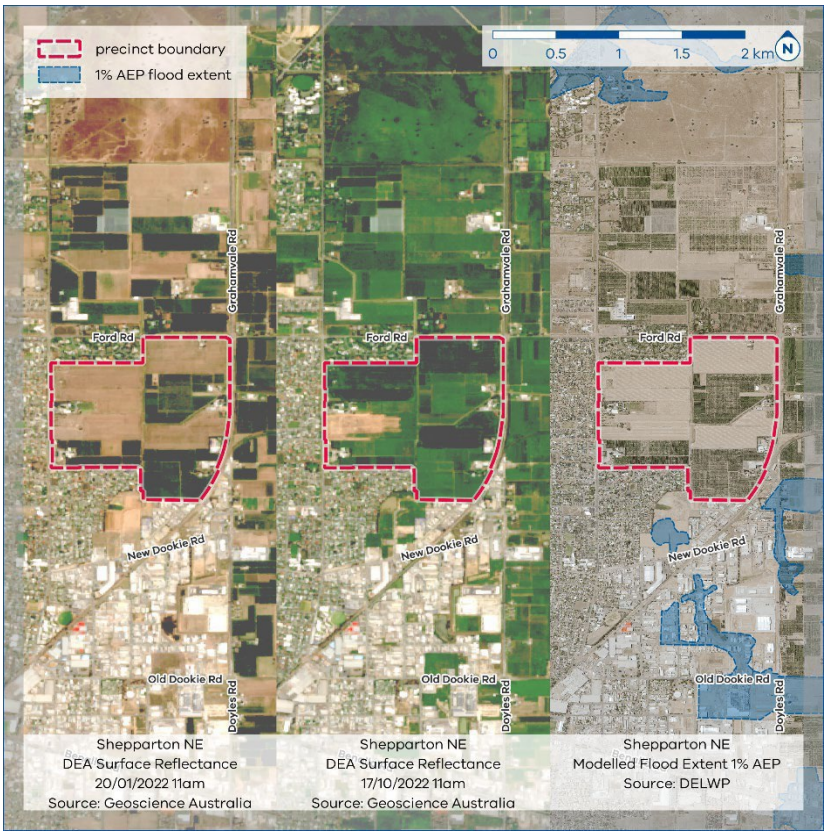
Left and Centre Images show flood extent in January, and October 2022 with the picture at the right showing the modelled 1% AEP flood extent.

ATTACHMENT 3



Left and Centre Images show flood extent in January, and October 2022 with the picture at the right showing the modelled 1% AEP flood extent

Shepparton South East PSP

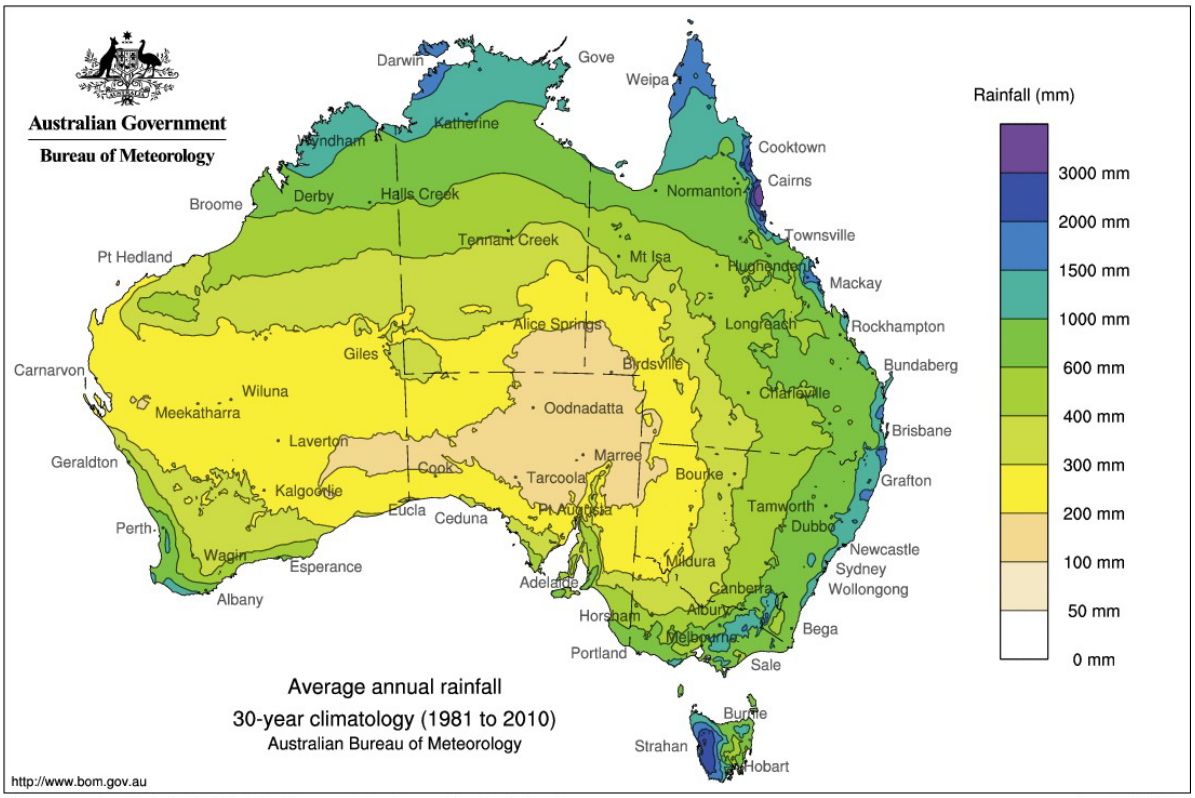


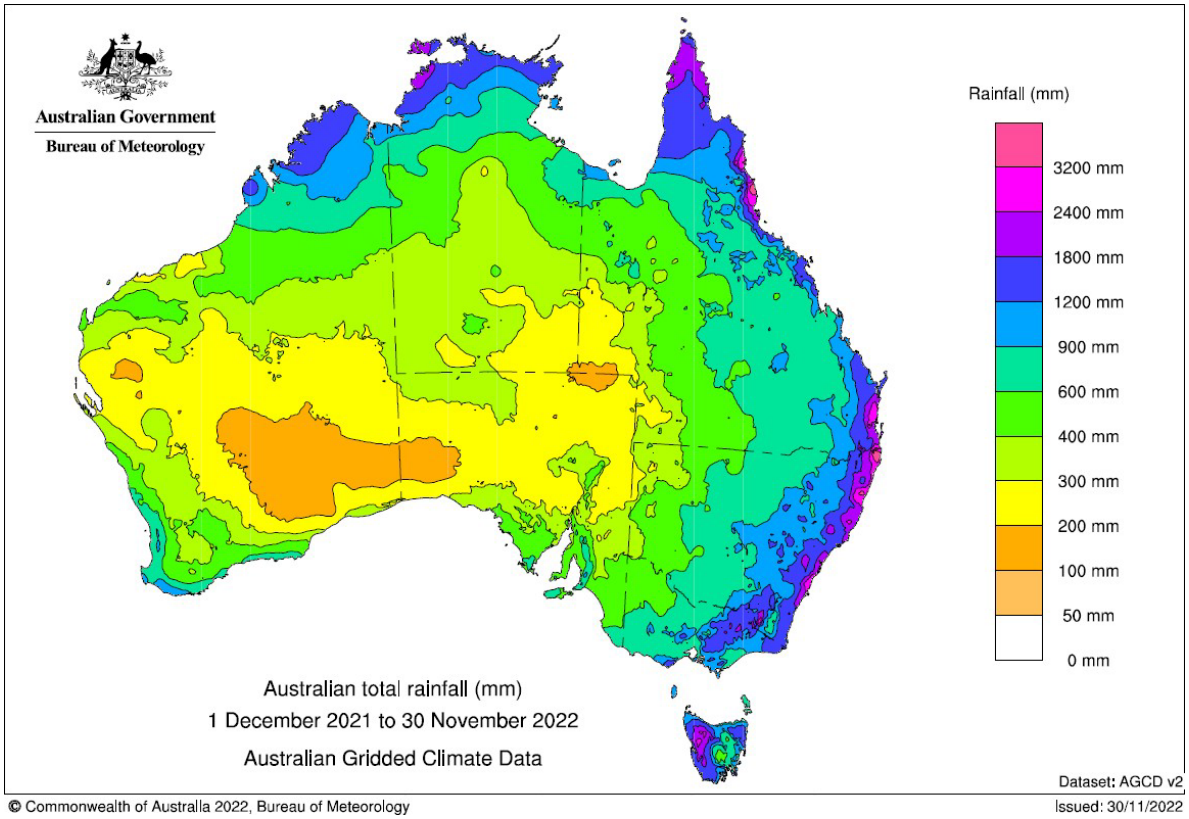
Left and Centre Images show flood extent in January, and October 2022 with the picture at the right showing the modelled 1% AEP flood extent

Shepparton North East PSP

ATACHMENT 4

The following images contain graphical plots sourced from the Bureau of Meteorology website, showing long-term average rainfall across Australia from 1981 to 2010, and rainfall across Australia to the 12 months ending 30 November 2020.





APPENDIX – VPA APPROACH TO FLOOD PLANNING

The purpose of this appendix is to provide additional context to the information outlined in the body of the Board Report, specifically expanding on key flood terminology, relevant national flood guidelines, the VPA's flood mitigation practises across different development settings, as well as ongoing considerations for flood planning in the context of intensifying climate change.

1. Definitions of flooding

In order to best plan for and mitigate the impacts of flooding, it is important to understand the three most common forms of floods and their distinct behaviours:

- Waterway (Fluvial) flooding is a natural phenomenon arising from rare or extreme rainfall events where the capacity of a waterway is exceeded, and the flow extends beyond the usual confines (banks) of the waterway into the adjoining floodplain. This type of flooding is typically generated by long duration storms (hours to days) over large catchment areas (up to thousands of square kilometres), involving large volumes of water, and it is associated with major flooding events and flood disasters over wide areas.
- Localised overland (Pluvial) flooding is typically generated by short storm durations (minutes to hours) within relatively small catchment areas (say less than 1 square kilometre). This type of flooding involves relatively small volumes of water and is associated with urban built-up areas.
- Coastal flooding occurs in low-lying coastal areas, including estuaries. It can be caused by storm surge events, very high tides, or both.

2. National flood assessment and mitigation standards

a. The Australian Rainfall and Runoff – A Guide to Flood Estimation (2019)

The key reference for assessing and designing for flooding in Australia is the "Australian Rainfall and Runoff – A Guide to Flood Estimation – May 2019" (AR&R). This is prepared jointly by the Commonwealth Government and "Engineers Australia" and provides comprehensive guidance for estimating flooding and designing for flood mitigation.

AR&R is a living document and is updated from time to time as required. It was first published in 1958 and the current 2019 version is the fourth edition, which replaces the third edition published in 1987. Major changes in the current edition are the inclusion of climate change procedures based on an Australian rainfall and flooding database.

AR&R outlines three main terms adopted to identify flood frequency:

1. "Annual Exceedance Probability (AEP" - the probability that a given rainfall event will occur or be exceeded within one year, expressed as a percentage – i.e. "X% AEP". This is the typical approach adopted for urban planning that the VPA undertakes.
2. "Average Recurrence Interval" - the average time period between occurrences equalling or exceeding a given rainfall event, expressed as "1 in X" year event. This is typically adopted for extremely rare events e.g. 1 in 1000 year etc. and applied to design of major infrastructure such as dam spillways.
3. "Exceedance per year (EY)" - the expected number of times per year for a particular storm event – expressed as "X EY". This is typically used to design minor stormwater infrastructure for more frequent localised (smaller) rainfall events.

This terminology is not interchangeable and can cause confusion and error if not understood and applied in the correct manner for a particular flood issue.

In AR&R, flood estimation is an essential procedure to assessing flooding. Under this approach, modelling is undertaken to quantify a particular rainfall event over a catchment, and then based on the catchment terrain and features, calculate the flow of water (extents, depth, and velocity) over that catchment. Most procedures in AR&R require computer software systems, due to the complex nature of estimating rainfall and modelling of predicated flooding.

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AR&R identifies that flood estimation provides essential information for understanding constraints and strategic land use planning, by:

- Identifying where and where not to develop.
- Assessing the cumulative impacts of development within the catchment and floodplain on flood flows and behaviour.
- Deriving development constraints that reduce the residual flood risk to the new development and its occupants to an acceptable level.

Historical rainfall and flooding data is the basis for all procedures outlined in AR&R. The national database prepared for the current edition of AR&R is the first time that it has been based entirely on Australian data. Historic rainfall charts specific to local conditions are presented in the form of intensity-frequency-duration (IFD) curves which indicate a range of rainfall intensities against the frequency and duration of events. These form the basis for calculating rainfall patterns within specific catchments and the resultant flooding.

3. Mitigating flood risk through land use planning in Victoria

Across Victoria, historical land-clearing and development within flood plains has placed property and people directly in the path of flood waters. Within flood plains, risks can be reduced through appropriate strategic planning and targeted interventions, but they cannot be avoided or removed entirely.

Within existing urban renewal sites, existing overland flooding may be mitigated by appropriate strategic and detailed flood planning, assessment, and management.

Greenfield development provides an opportunity to appropriately plan, to minimise impacts of flooding. As far as practicable, planning for urban development should confine flooding to appropriate conveyance and storage areas, while preventing flood waters from entering residential floorspaces.

Development should not occur in areas predicted to have a high flood risk in coming decades unless strategies are in place to mitigate the impacts.

4. VPA's approach to flood mitigation across Victoria

In Victoria, there has been a strong move away from adopting simple flood practise standards to a risk-based approach where the consequences and probability of design capacity being exceeded are assessed explicitly.

Flood risk is a combination of the likelihood (or probability) of a flood occurring and the consequences of that flood. It is determined by the frequency of flooding and the potential economic, social, and environmental consequences to the community. They are interlinked, and generally the less frequent the event, the larger the potential consequences.

While flooding is a natural hazard, unlike most other natural hazards, floods are to a great degree predictable in terms of their location, depth, and extent. This means that the VPA is able to build appropriate control/mitigation measures into our planning projects. Through careful land use planning flood risks to life, property and community infrastructure can be minimised and the environmental significance of our floodplains protected.

By using up-to-date data and undertaking integrated drainage and flood mitigation planning, the VPA works collaboratively with flood plain managers and local councils to better plan, manage and mitigate flood risk in areas where we are undertaking planning projects.

Proposed flood mitigation works are rigorously interrogated during the exhibition phase of a PSP and through the Planning Panels Victoria process across all development contexts, therefore any flooding assessments need to be undertaken to a high level of sophistication.

a. Metropolitan Melbourne – Urban Renewal

In accordance with AR&R, urban areas are designed to ensure properties are not inundated from the effects of flooding from a 1% AEP rainfall event. Floor levels for dwellings are then set with a minimum height above the identified flood level (referred to as "freeboard"), usually a minimum of 600mm in Metropolitan Melbourne.

In urban renewal areas in Melbourne, the VPA undertakes extensive work to model flooding and prepare drainage solutions in line with state government planning benchmarks and in consultation with Melbourne Water, to manage flooding and drainage and to enable development.

Typically, there have been significant existing flooding issues associated with urban renewal projects – for instance Arden Macaulay, Bentleigh East, and Clayton Business Park. In these instances, the VPA approach has been to assess flooding in accordance with AR&R, generally consisting of the following:

- Flood modelling to identify the existing flood extents, depths, and velocities under current climate conditions.
- Flood modelling to identify flood extents, depths, and velocities for the future developed scenario factoring in climate change impacts to the year 2100.
- Incorporate flood mitigation measures to ensure public safety and facilitate a development outcome
- Ensure site safety criteria is achieved (flood depth and velocity).
- Demonstrate that flooding is no worse either upstream or downstream of the planning site post development.

b. Metropolitan Melbourne – Greenfields

In metropolitan Melbourne and greenfield areas, Melbourne Water is the designated regional drainage and flood plain manager, while the local council is the responsible authority for local drainage.

During the preparation of PSPs, the VPA works closely with Melbourne Water while it prepares a Development Services Scheme (DSS) to manage flood volume to a 1% Average Exceedance Probability (AEP) and treat stormwater quality to best practice requirements prior to its discharge to receiving waterways.

Land-take and drainage scheme requirements are ultimately provided by Melbourne Water and then incorporated into the Place Based Plan and PSP by the VPA.

c. Regional Victoria

Unlike in greenfield areas, there are typically no drainage schemes like the Melbourne Water DSS in Metropolitan Melbourne, and often there can be limited flooding data available in regional contexts.

Under these circumstances, the VPA needs to undertake flood assessments and prepare proposed drainage solutions for inclusion into the PSP and DCP. Solutions typically include provision of open waterways for flood conveyance, retarding basins for flood storage, as well as drainage pipes/culverts and wetlands to treat polluted stormwater runoff in accordance with current best practice guidelines as well as state government planning benchmarks. The VPA works closely with Catchment Management Authorities and local councils to prepare these concept-level solutions, for ultimate detailed implementation by others following PSP finalisation.

Relatively detailed drainage designs and cost estimates are required to support the planning process and preparation of a Developer Contributions Plan. This is achieved by firstly preparing a high-level drainage strategy, and then progressing this to "*functional*" designs and cost estimates. Based on AR&R, all flood modelling and drainage designs in regional settings include allowances for climate change in accordance with local circumstances.

5. Ongoing considerations for flood mitigation and planning

a. Intensifying climate change

Appropriate consideration of flooding and potential impacts of climate change has been brought into sharper focus due to the recent flooding events which have occurred both nationally and across Victoria.

There is now widespread acceptance that human activities are contributing to observed climate change. Victoria's climate has changed in recent decades, becoming warmer and drier. If global emissions continue to increase, these changes are expected to continue and intensify.

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In terms of flooding, intensifying climate change could result in more intense downpours and a decline in cool season rainfall. Victoria's climate also varies from year to year and decade to decade due to the influence of large-scale drivers such as the La Nina. Now into its third year, La Nina increases the chance of above average rainfall for northern and eastern Australia during summer.

Victoria's Climate Science Report 2019 suggests a 7% increase in the intensity of extreme rainfall estimated for each degree of warming and a 14% increase observed in the most extreme short-duration rainfall extremes in Victoria.[1]

Climate Change has the potential to impact on the design and assessment of flooding in the following ways:

- Rainfall intensity Frequency Duration (IFD) relationships
- Rainfall temporal patterns
- Continuous rainfall sequences
- Antecedent (pre-storm) conditions and baseflow regimes
- Compound extremes (riverine flooding combined with storm surge inundation and local overland flooding).

7. AR&R's response to climate change

According to AR&R, the magnitude of intensifying climate change and implications for flooding has to date not been subject to comprehensive study, either nationally or internationally.

However, with regards to adopting a Climate Change approach for flood estimation, AR&R states:

- Generally, there is more confidence in General Circulation Model (GCM), simulations of temperature than for rainfall.
- Given the uncertainty in rainfall projections and their considerable regional variability, an increase in rainfall (intensity or depth) of 5% per degree Celsius of local warming is recommended
- The procedures relating to climate change will be updated as new and detailed research findings are released.
- One of the most fundamental issues in detecting trends in precipitation or discharge data due to climate change is separating the influences of climate change variability from long-term climate change.

8. VPA's response to climate change and intensifying flood risk

Climate modelling shows that heavy rainfall events will be more frequent and intense, and sea level will continue to rise, increasing the severity and frequency of flooding in Victoria. However, even with the most up to date mapping and modelling for climate change, impacts on land use planning still remain significantly uncertain. We expect to see this uncertainty continue in climatic processes such as the frequency, duration, and intensity of climate and subsequent flooding events.

Current Victorian State Policy addresses the risks and coastal impacts associated with climate change by planning for sea level rise of 0.8 metres by 2100 and allowing for the combined effects of tides, storm surges, coastal processes when accessing risks and coastal impacts associated with climate change (Clause 13.01-2S).

As outlined throughout the body of the Board Report, the role of the VPA with regards to flood planning is to translate state-wide planning benchmarks set by the Department of Transport and Planning (DTP) and supported by *the Planning and Environment Act (1987),* into localised approaches to flood assessment and mitigation at the PSP level. While the VPA recognises the importance of imposing higher flood standards in anticipation of intensifying climate change, the VPA is ultimately guided by the requirements set out in existing state policy frameworks.

[1] Climate Science Report 2019 DELWP p.32 https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0029/442964/Victorias-Climate-Science-Report-2019.pdf