



# Nowra Riverfront Precinct Flood Impact and Risk Assessment

Final Report

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### Executive Summary

The Nowra Riverfront Precinct (the Precinct) Flood Impact and Risk Assessment (FIRA) has been prepared for Shoalhaven City Council (Council) to define the existing flood behaviour in the catchment and to assess, and address, if necessary, the potential impacts arising from the proposed future development of the Precinct.

#### Objectives

The purpose of this Study was to determine if:

- Changed flood behaviour associated with the concept form of the Precinct could arise and have adverse impacts on the flood risk to the existing community and development;
- The proposed development within the Precinct and its users or occupants can be enabled with an acceptable level of flood risk; and
- Effective flood emergency response is achievable without adverse impacts on the ability of the existing community to respond to floods.

The FIRA is required to establish at concept level whether the proposed Precinct works would result in impacts that are localised and / or can be readily managed. The FIRA can also be used to support/inform land-use rezoning processes, planning proposals, inform development applications against the SLEP and SDCP (in particular the safe occupation and evacuation requirements of the SLEP) and the establishment of development controls for future development in the Precinct.

#### Background

The Precinct is an important location that Council plan to utilise to strengthen the role of the Nowra Riverfront Precinct as a civic, community, tourism, and recreational hub for the Shoalhaven region.

Urban design consultants, Studio GL, were engaged in 2018 to prepare recommendations for planning and development controls. Studio GL made a number of recommendations for changes to existing zones, floor space ratios and height controls, and prepared preliminary masterplans.

The preliminary sub-precinct layout developed by Studio GL is shown in **Figure i**.



**Figure i** Proposed Sub-precincts (Source: Studio GL)

## Technical Working Group

The involvement of key stakeholders has been an important part of this study. To this end, a series of four Technical Working Group (TWG) workshops have been undertaken over the course of the study.

The aim of the TWG workshops was to provide a means of engagement with key stakeholders, and to provide early and ongoing opportunities to provide feedback and comment on the progression of the FIRA.

These workshops were held throughout the project, namely:

- TWG1: Undertaken on 15 December 2021, the first TWG workshop was held to present the results of the base case flood modelling, and to invite comments and suggestions for the development of future scenarios and options for assessing in the hydraulic model. The presentation and comments received are provided in **Appendix B**.
- TWG2: Undertaken on Monday 21 February 2022. The workshop was held to present the results of the concept option flood modelling, and to invite comments and suggestions for the development of scenarios that warranted further assessment. The presentation from the workshop is provided in **Appendix C**.
- TWG3: The third TWG workshop was held on 7 June 2022. The workshop was held to present the results of the Flood Planning Level (FPL) assessment, the NSW SES evacuation modelling, site specific development controls, and the development of a set of performance criteria for the assessment of various landform options. The presentation from the workshop is provided in **Appendix D**.
- TWG4: The draft FIRA was reviewed by stakeholders, namely NSW State Emergency Service (SES), Department of Planning and Environment (DPE) and Transport for NSW (TfNSW) prior to its finalisation. As part of this review, an initial workshop with SES and DPE was held on 21 February 2023 to discuss the comments submitted. Following this, a fourth TWG workshop was convened on 3 April 2023 to further discuss comments received and how the FIRA should be revised to address them. Provided in **Appendix G** is a summary of how the report was revised in light of these comments, as well as the submissions received from stakeholders.

## Existing Flood Behaviour

Flood modelling has been undertaken for the 20%, 10%, 5%, 1%, 0.5%, 0.2 and 0.05% Average Exceedance Probability (AEP) events and the Probable Maximum Flood (PMF) event in accordance with Australian Rainfall and Runoff, 2019 (Commonwealth of Australia (Geoscience Australia), 2019).

For local catchment flood events, outside of the central flood storage area (the open space area between the Mandalay sub-precinct and the Hyam Street and Scenic Drive sub-precincts), the flood affectation is minimal, and typically confined to the road reserves for all modelled events. The exception to this is that in the PMF, the portion of the Precinct east of the highway experiences inundation of developed areas as a result of backwater flooding from the Lower Shoalhaven River (assumed to occur at the same time as a local catchment flood event).

For riverine floods, the riverbank first overtops in the 5% AEP event immediately upstream of Nowra Bridge, with flows spilling into the central open space of the Precinct. Flow first breaks out of the river adjacent to the south-western embankment of the recently completed bridge across the Shoalhaven River and flows through the existing low point adjacent to the Nowra Aquatic Park. The 5% AEP levels in the central depression are 0.08m higher for a riverine flood, compared to the 5% AEP local catchment

event. This trend intensifies for larger events, with the 1% AEP being 0.5m higher in a riverine flood compared to a local flood event, and the PMF is 3.5m higher for riverine floods. As such, catchment-driven flooding governs the local flood behaviour up to the point at which the riverbank overtops (the 5% AEP), after which peak flood levels in the Precinct are governed by riverine flood levels.

### Flood Planning Level Assessment

To inform the setting of Precinct Flood Planning Levels (FPLs) an assessment was undertaken for three FPL options:

- The 1% AEP + Sea Level Rise (SLR) + Rainfall Increase (RI) + Freeboard
- The 0.5% AEP + Sea Level Rise (SLR) + Freeboard
- The 0.5% AEP + Sea Level Rise (SLR) + Rainfall Increase (RI) + Freeboard.

Each scenario was assessed for:

- Benefits to flood warning and evacuation
- Benefits to risk in likelihood of flooding
- Impact on developable area
- Integration with adjacent infrastructure
- Aesthetic and open space integration considerations.

Following this assessment, for investigations as part of this study, it was elected to set the level of the Precinct building pads at the 0.5% AEP +SLR +0.5m freeboard. This outcome was consistent with the recommendations from the Lower Shoalhaven River Flood Study (Cardno, 2022).

### Options Development

To allow the assessment and comparison of the various options to be assessed, and to determine which options could be considered feasible, a set of performance criteria were developed. The adopted criteria evolved from discussion at the second TWG meeting (on 15/12/2021) concerning what a “successful” option would deliver, as well as consultation with Council and DPE technical personnel.

A raised building pad was determined to be the primary means by which flood risk could be managed on site as this design approach seeks to provide a level of flood protection for the proposed buildings for both local catchment and riverine flood events, and to assist with flood evacuation through the provision of additional evacuation time.

Various landform options for the Precinct were assessed using flood modelling to determine the maximum extent the raised building pad levels could take up without adversely affecting flood behaviour.

Through an iterative approach, a pad arrangement was determined that maximised the developable area of each sub-precinct, whilst not resulting in adverse flood behaviour.

The assessment found that the proposed building pads would result in a water level increase over Hyam Street and adjacent properties for the local catchment 1% AEP. Further testing showed that this impact could be mitigated by either constructing a second stormwater outlet to the Lower Shoalhaven River, or by reducing the Mandalay, Hyam Street and Scenic Drive pads by 7.5m, adjacent to the central open space.

## Flood Emergency Response

Flood warning time and evacuation potential were both assessed for the Precinct. The assessment found that a warning time of 8 to 10 hours was available, and that rising road access to flood free land was achievable for the Mandalay Avenue, Scenic Drive and Hyam Street sub-precincts. The Wharf Road, Pleasant Way and Bridge Road sub-precincts were determined to be low flood islands.

The NSW SES undertook evacuation modelling for three population estimates for each of the sub-precinct areas.

The assessment found that all sub-precincts had sufficient time to evacuate, subject to the population and SES resourcing (number of door knocking teams) assumptions:

- Scenic Drive and Bridge Road had sufficient time to evacuate under all population and SES team assumptions;
- Mandalay Avenue had sufficient time to evacuate under the low population scenario, or if two or more teams were deployed, the medium population scenario;
- Hyam Street had sufficient time to evacuate under the medium population scenario, or if three SES teams were deployed, the high population scenario;
- Pleasant way was sensitive to the SES team assumptions. Evacuation was feasible only for the low population scenario with one team, up to the medium population scenario with two teams, or up to the high population scenario with three teams;
- Wharf road had sufficient time to evacuate for all population scenarios if two or more SES teams were deployed. If only one team was deployed, Wharf Road could only be evacuated under the low population scenario.

Following the assessment, the SES provided the following comments:

- The SES do not recommend residential or tourist development in places where people may be trapped in a low flood island (i.e., the Wharf Road Sub-precinct).
- In large flood events SES resources will be required to be deployed across much of the South Coast and regional access routes are likely to be cut due to flooding. As such, while the assessment indicated that evacuation is feasible within the available warning time, it needs to be recognised that the ability of the SES to respond in a large flood event will be constrained by regional flooding and that occupants should be provided with the information necessary to self-evacuate.
- Flooding in the Nowra Riverfront Precinct offers significant risks to those that choose not to evacuate or become trapped by flood waters. PMF flood depths and velocities are such that rescue and/or resupply may be too risky for emergency personal to attempt.
- There is never a complete uptake of evacuation commands. A portion of occupants will always elect to remain, and their eventual rescue puts SES personnel at risk.

However, they noted that the tool used to determine this estimate was developed for the Hawkesbury Nepean floodplain where properties are much more dispersed, and evacuation distances are much greater than that for the Precinct.

The proposed development controls identified in this report (**Section 14**) have been prepared on the basis that the Precinct development does proceed. On that basis, the controls have been prepared to minimise, as much as possible, the SES management requirements.

With respect to the development controls and emergency evacuation, it is noted that the Wharf Road, Pleasant Way, and Bridge Road sub-precincts are classed as low flood islands and become isolated prior to inundation of the sub-precinct.

This is particularly the case for Wharf Road, where access is lost prior to the full pad becoming inundated. For Pleasant Way and Bridge Road, overland escape routes remain available when the lower portion of the sub-precincts become inundated, but this overland access is lost prior to the full sub-precinct becoming inundated, hence the low-flood island classification.

At the Probable Maximum Flood (PMF) flood peak, the Wharf Road sub-precinct is covered by H6 hazard flooding and velocities in excess of 4m/s. Such flooding conditions are likely to prevent any SES rescue by boat, in the event that occupants refused or where unable to evacuate. The higher points within the Bridge Road and Pleasant Way sub-precincts have a hazard class of H1, although H6 hazard is present along all surrounding roadways. While velocities between these two highpoints exceeds 4m/s along the highway, the surrounding velocities are lower, in the order of 1-2m/s. These lower hazard and velocities may enable access via boat during the course of the flood, although this should not be relied upon.

From a flood risk perspective, constructing high density residential development on a low flood island where flood inundation could be expected to be longer than 36 hours in the PMF event is inconsistent with the SES requirements for evacuation, and the Wharf Road sub-precinct is not considered suitable under the isolated, raised pad scenario assessed in this report. To permit development on the Wharf Road sub-precinct, some form of pedestrian, if not vehicle, access must be provided to connect the sub-precinct to land above the PMF. It is noted that the SES do not support pedestrian evacuation as the primary evacuation strategy.

The Pleasant Way and Bridge Road sub-precincts have this overland connection at the FPL (and at higher events up to and including the 0.05% AEP event). When the pads first overtop, there is overland access across the Princes Highway from the Pleasant Way sub-precinct to the Bridge Road sub-precinct, and from there to flood free land and flood refuges in Nowra CBD. These access routes are lost approximately 6 hours prior to the full sub-precinct becoming inundated in the PMF event.

The Wharf Road pad has a more adverse flood behaviour. Access along surrounding roads, and to the adjacent Pleasant Way sub-precinct are lost prior to the pad being inundated. This occurs in the 0.05% AEP when flows overtop the highway from the west and flow down Pleasant Way. At this point, the pad remains dry, but all access is lost.

While this would ultimately be up to any future development to address, it is suggested that possible strategies may be:

- Raising some portion of the western end of Pleasant Way to allow for pedestrian access at the FPL from the Wharf Road sub-precinct across the highway to flood free land west of the Bridge Road sub-precinct.
- Raising the western end of Pleasant Way to allow vehicular access from Pleasant Way to the Princes Highway at the FPL as a minimum. This would improve the evacuation potential of both Wharf Road and Pleasant Way sub-precincts.
- Filling of the western depression between the Wharf Road pad and the Princes Highway to the FPL to allow pedestrian access onto the Highway, and from there to the Pleasant Way sub-precinct



from which overland access is available to flood free land in Nowra CBD. It is noted that this land is owned by TfNSW.

- Construction of a pedestrian bridge or similar over Pleasant Way to allow for overland evacuation from the Wharf Road sub-precinct to the Pleasant Way sub-precinct from which overland access is available to flood free land in the Nowra CBD.

### Flood Communication System

Given the differences between the study area and the regions for which the evacuation timeline methodology was developed, there are potential additional measures to assist in the evacuation of the Riverfront Precinct that would be feasible, most notably a flood communication system capable of manual alerts. The purpose of this communication system is to reduce the time required for the mobilisation and warning stages of the evacuation timeline above.

Providing a means by which occupants are able to assist in their own evacuation is desirable. While the SES has undertaken this assessment assuming up to three teams may be available, the reality is that a flood of greater than the 0.5% AEP (which would threaten to inundate the proposed pads) would see widespread flooding and road closures across potentially numerous areas on the south coast and the Greater Sydney region, placing substantial numbers of people at risk, and stretching the ability of the SES to respond in all locations. Warnings that can be issued automatically or remotely, will assist in allowing the study area to evacuate, without the physical presence of SES teams, and could potentially reduce the SES door knocking timeframe by encouraging and assisting occupants to evacuate early. It is noted that the SES would still door knock each property, but if occupants have already evacuated, the time needed for communication would be reduced.

The system has been termed a “communication” system as its purpose is not to issue warnings or alerts (which are the purview of BoM and SES) but rather to facilitate the communication of these warnings and alerts from the SES to building occupants. It is envisaged that the system would be able to issue both pre-recorded and live announcement, both on- and off-site, at the discretion of the SES.

However, with this considered, it is important to recognise that the SES has identified that there will be difficulties in managing the evacuation of the proposed Precinct, and this should be considered in any decisions for the feasibility of the development. This was further iterated by the SES during the Technical Working Group 3 and 4 discussions.

The subsequent controls identified in this report (**Section 14**) have been prepared on the basis that the development does proceed. On that basis, the controls have been prepared to minimise, as much as possible, the SES emergency response requirements.

Any flood communication system developed for the Precinct should:

- Be capable of issuing pre-recorded and live announcements / warnings / alerts both on- and off-site at the discretion of the SES. The communications could be staged, with an initial warning given to occupants to allow time to process the need for evacuation before the official evacuation order is given. This would serve to maximise the time available for the actual evacuation process.
- Have appropriate redundancies to ensure that it remains operable in a flood event.
- Incorporate regular testing to ensure it remains operable, and that occupants become familiar with the warnings that would be issued in a large flood event.

- Be maintained by a suitability qualified third party. It is not considered suitable that building owners be responsible for this system. Building developers/owners should be required to contribute to the costs of implementing and maintaining the system, but the maintenance should lie with a third party and operation should be by the building operator / manager at the direction the SES. This ensures that the system will be maintained and operated appropriately and serves to mitigate the risks that the system would fall into dis-use, or, in the case of the building being sold on, that subsequent owners are not fully aware of its use and requirements.
- While the assumption that the flood communication system is able to offer improvements in the warning and response timeline are reasonable, it is noted that the SES would still be required to visit the property, and whilst it would be expected that many occupants would respond to the warnings, it is not possible to state conclusively the extent to which this would be the case.

Flood warning systems and site flood response plans are not without challenges.

To address these issues, it is recommended that any flood communication system developed be designed and maintained by an appropriately experienced and qualified third party, with both upfront and ongoing costs leveraged on the Precinct developers / owners. Such an arrangement ensures that that the building owners retain financial responsibility for the warning system, and that funds for the ongoing costs of the system are made available, irrespective of ownership of the buildings. The third party would then be responsible for maintenance, and testing, with the SES retaining responsibility for communications, alerts, and warnings.

Whilst beyond the scope of this study, Council may also wish to ensure that any system developed has the potential to be expanded upon so as to draw in both existing and future development if and when required.

### Planning and Policy Review

A review was undertaken of relevant NSW Government and Council planning and policy documents.

The primary aim of the review was to determine if the proposed Precinct landform and associated works would be compatible with NSW Government and Council's planning and development control requirements (being those in force as of September 2022).

The review found that the proposed Precinct plan of raised buildings pads, accompanied, if necessary, by flood mitigation works, would be in accordance with the Shoalhaven Local Environment Plan (LEP) (2014) and Development Control Plan (DCP) (2014), and would generally be in accordance with the Ministers Local Planning Directions issued on 1 March 2022 under Section 9.1(2) of the *Environmental Planning and Assessment Act, 1979*.

The key exceptions to this are:

- The construction of residential development within high hazard zones (only applicable if the PMF is adopted as the residential FPL), which conflicts with Planning Direction 4.1(3);
- The location of the Wharf Road sub-precinct in the PMF floodway, which conflicts with Planning Direction 4.1(4)(a);
- The increased residential development within the PMF extent, which conflicts with Planning Direction 4.1(4)(c) – it is noted that some regions of the Mandalay Avenue sub-precinct are outside of the PMF, and as such, are in compliance with this control; and,

- The additional burden placed on emergency services to manage the evacuation of the Precinct, which conflicts with Planning Direction 4.1(4)(f).

The Planning Direction does allow for inconsistencies with these requirements if:

*the planning proposal is supported by a flood and risk impact assessment accepted by the relevant planning authority and is prepared in accordance with the principles of the Floodplain Development Manual 2005 and consistent with the relevant planning authorities' requirements (Direction 4.1 (5) (c)).*

This Flood and Risk Impact Assessment has been prepared to demonstrate that the proposed development of the Precinct can be undertaken in such a way as to reduce the impacts of these departures from the Planning Directions to an acceptable level and enable a future Planning Proposal to comply with it.

The residual risk present across the Precinct is proposed to be managed by planning and development controls (refer **Section 14**), which contain explicit controls to reduce the risk to occupants and the burden placed on emergency services in the event of a flood event.

A summary of all planning controls that are either non-compliant, or not fully compliant are summarised in **Table i**.

#### **Precinct-Specific Draft Development Controls**

Development within the Precinct will be guided by site-specific development control plan provisions. As part of this study, draft flood-related controls were prepared for inclusion in this future document. The focus of the controls is on managing the considerable residual flood risk present on the site as a result of the significant PMF depths.

Controls were developed with regard to:

- Building Pad Levels – The adoption of an FPL, based on the 0.5% AEP, incorporating sea level rise and freeboard;
- Fill - Allowable extents and levels of filling within the floodplain, to achieve the building pad levels and extents;
- Flood warning and evacuation - requiring buildings developed on site to be connected to a flood communication system;
- Carparking (both open and basement) - to ensure that these locations remain safe for users during a flood event, and that vehicles do not become caught up in flood waters;
- Structural soundness - The PMF depths over the proposed buildings in the Precinct would be in excess of 3m, and as a result, all buildings will be required to demonstrate that they are capable of withstanding these flood forces.

Table i Partial and Non-Compliance with Relevant Plans and Directions

Clause	Objective / Control	Compliance
SLEP 5.21 (adopted)	Development will not affect the safe occupation and efficient evacuation of people in a flood event	<p><b>Largely Compliant.</b></p> <p>Actions have been taken to ensure that occupants of the Precinct are made as safe as possible during large flood events. FPLs have been set at the 0.5% AEP + 2100 SLR + 0.5m freeboard, providing long term flood protection for events up to and including the 0.5% AEP. For larger events, development controls are recommended to manage residual risk, including flood warning and the provision of rising road or pedestrian access at the FPL to facilitate evacuation.</p> <p>However, not all flood risk can be removed from the Precinct and some residual risk will remain despite these measures.</p>
SDCP G9 5.1	The development will not increase the risk to life or safety of persons during a flood event on the development site and adjoining land.	<p><b>Largely Compliant.</b></p> <p>Similar to the SLEP above, the risk has been mitigated as far as reasonably practical, but some residual flood risk in extreme events remains. To manage the risk to life, FPLs have been set at the 0.5% AEP + 2100 SLR + 0.5m freeboard, providing long term flood protection for events up to and including the 0.5% AEP. For larger events, development controls are recommended to manage residual risk, including flood warning, use of flood compatible building materials, and the use of the PMF to inform structural soundness.</p> <p>SES evacuation modelling has been undertaken to inform what development densities can be evacuated within the available warning time.</p>
	The development will not unduly increase dependency on emergency services.	<p><b>Partly Compliant.</b></p> <p>Development controls for the site require the implementation of a communication system. The system would be capable of issuing flood communications and directions from the SES in order to facilitate the actions of the SES during a flood event.</p> <p>Ultimately however, it would be up to the SES to comment on how much assistance the proposed system would offer. It has been recommended that the system be developed in consultation with the SES in order to ensure it provides as much assistance as possible.</p>
SDCP G9 5.4.5	Owners (within the Riverview Road FMRP Study Area) must have measures in place to enable them to self-evacuate to not place additional burden on Emergency Services	<p><b>Partially Compliant</b></p> <p>The site specific DCP controls include controls to reduce the impact of the development on emergency services. However, an explicit control to have owners provide measures to enable self-evacuation has not been included.</p>

Clause	Objective / Control	Compliance
	No new subdivisions within the Riverview Road FMRP Study Area	<b>Compliant provided that no subdivision was proposed.</b> Compliance against this criterion is dependent on the development proposal and would be compliant provided that no subdivision was proposed as part of the development.
Ministerial Directions 4.1(3)(a)	permit development in floodway areas	<b>NOT COMPLIANT.</b> The Wharf Road sub-precinct sits within the PMF floodway. All other sub-precincts are compliant. It is not feasible to alter the floodway of the Shoalhaven River. As such, compliance with this direction would require that the Wharf Road sub-precinct remain undeveloped.
Ministerial Directions 4.1(3) (c)	permit development for the purposes of residential accommodation in high hazard areas	<b>NOT COMPLIANT</b> In the PMF event, the Scenic Way, and Wharf Road sub-precincts, as well as portions of all other sub-precincts are within H5 or H6 flood hazard categories. Locating residential development on higher ground within the Mandalay Avenue, Hyam Street and Bridge Road developments, and restricting residential development on the Scenic Drive and Wharf Road sub-precincts would limit the extent of the non-compliance.
Ministerial Directions 4.1(3) (d)	permit a significant increase in the dwelling density of that land	<b>NOT COMPLIANT.</b> The proposed development would result in a significant increase in the dwelling density of the land within the PMF. Adopting a low population scenario and/or limiting residential land uses would limit the extent of the non-compliance.
Ministerial Directions 4.1(3) (g)	are likely to result in a significantly increased requirement for government spending on emergency management services, and flood mitigation and emergency response measures, which can include but not limited to road infrastructure, flood mitigation infrastructure and utilities	<b>Partially Compliant.</b> While the development of the Precinct is likely to impose a cost relating to emergency management and response, the planning controls developed for the Precinct aim to transfer the additional funding responsibility to the developer/owner (via the imposition of Covenants) with regard to emergency warning and evacuation. However, the development would likely increase resourcing requirements for the SES, even with the warning system and other emergency related development controls in place.
Ministerial Directions 4.1(4)(a)	A Planning Proposal will not permit development in floodway areas	<b>NOT COMPLIANT.</b> The Wharf Road sub-precinct sits within the PMF floodway. All other sub-precincts are compliant. It is not feasible to alter the floodway of the Shoalhaven River. As such, compliance with this direction would require that the Wharf Road sub-precinct remain undeveloped.

Clause	Objective / Control	Compliance
Ministerial Directions 4.1(4) (c)	A Planning Proposal will not permit a significant increase in the dwelling density of that land	<b>NOT COMPLIANT.</b> The proposed development would result in a significant increase in the dwelling density of the land within the PMF.  Adopting a low population scenario and/or limiting residential land uses would limit the extent of the non-compliance.
Ministerial Directions 4.1(4) (d)	A Planning Proposal will not permit the development of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate	<b>To be determined.</b> The final usage of the proposed premises of the Precinct have not yet been determined. It is noted that the direction has the potential to limit what activities may be able to be approved for the development.
Ministerial Directions 4.1(4) (f)	A Planning Proposal not likely to result in a significantly increased requirement for government spending on emergency management services, and flood mitigation and emergency response measures, which can include but not limited to road infrastructure, flood mitigation infrastructure and utilities	<b>Partially Compliant.</b> While the development of the Precinct is likely to impose a cost relating to emergency management and response, the planning controls developed for the Precinct aim to transfer the additional funding responsibility to the developer/owner (via the imposition of covenants, conditions, or development consents) with regard to emergency warning and evacuation. However, the development would likely increase resourcing requirements for the SES, even with the warning system and other emergency related development controls in place.

## Recommendations

As a result of the assessments undertaken as part of this study it has been recommended that:

- Raised building pads be adopted as the preferred flood management strategy. The recommend layout of the raised pads is shown in **Figure i**. Raised building pads were determined to be the primary means by which flood risk could be managed on site as this design approach seeks to provide a level of flood protection and immunity for the proposed buildings and occupants for both local catchment and riverine flood events, and to assist with flood evacuation though the provision of additional evacuation time.
- That these pads be set at an FPL level based on the 0.5% AEP + Sea Level Rise (SLR) + Freeboard, which is also consistent with the Lower Shoalhaven Flood Study (Cardno, 2022).
- The proposed pads result in a flood level increase across Hyam Street for the 1% AEP local catchment event. This impact can be managed via two mechanisms:
  - The construction of an additional outlet culvert from the central open space region.
  - Alternatively, a 7.5m reduction in the width of the building pad adjacent to the open space region can applied to the Mandalay, Scenic Drive and Hyam Street sub-precinct pads to provide additional storage and remove this impact.

- A property flood and ground level survey has been recommended for those properties on Hyam Street affected by the increase in 1% AEP local flood levels. The purpose of this assessment is to determine what impact the 0.04m has on property freeboard, and to assist in determining if compensation for or voluntary purchase of these properties is a viable alternative to the implementation of one of the above structural options.
- Site specific development controls be implemented to address and manage the residual flood risk.
- Residential development has been recommended to be focused on those regions with rising road access, namely Mandalay Avenue, Scenic Drive and Hyam Street sub-precincts. The remaining pads, which are all low flood islands in the PMF, have been recommended as more suited to lower population density land uses such as tourist accommodation or commercial premises.
- Land uses for each sub-precinct, as summarised in **Table i**.

**Table i Recommended Land Uses for Sub-Precincts**

Sub-Precinct	Recommended Land Uses	Not Recommended Land Uses
Mandalay	All uses suitable. Residential recommended to be located here in preference to eastern sub-precincts	
Hyam Street		
Scenic Drive		
Bridge Road	Tourist, Commercial	Residential
Pleasant Way		
Wharf Road		

Overall, the FIRA report has demonstrated that flooding risks for the western sub-precincts excluding Bridge Road (Mandalay, Scenic Drive, and Hyam Street) have been appropriately addressed, and that the proposed land use types for these sub-precincts are consistent with the flood risk profile.

The eastern sub-precincts (Pleasant Way and Wharf Road) and Bridge Road are all low flood islands and present a higher flood risk profile. Whilst the FIRA has demonstrated that lower population density land-uses are suitable for these sub-precincts (such as commercial or tourist uses), the inclusion of residential development within the sub-precincts would require further, sub-precinct specific assessments into, at a minimum:

- The ability to provide pedestrian egress routes to higher ground west of the Princes Highway for all eastern sub-precincts (noting that SES does not support pedestrian evacuation as the primary evacuation strategy); and,
- Raising of Pleasant Way to facilitate the evacuation of Pleasant Way and Wharf Road sub-precincts. Coincident works to the Pleasant Way highway intersection may also be required, or desired, in order to improve emergency management. These works would alter the risk profile of the eastern sub-precincts by changing the emergency response classification of these sub-precincts from low flood islands to rising road. This would be beneficial for any future development in the Wharf Rd and Pleasant Way sub-precincts and would also provide improvements to evacuation ability for the existing Riverview Road area.





Figure i Recommended Raised Pad Extents to Prevent Adverse Flood Impacts