

## Foreword

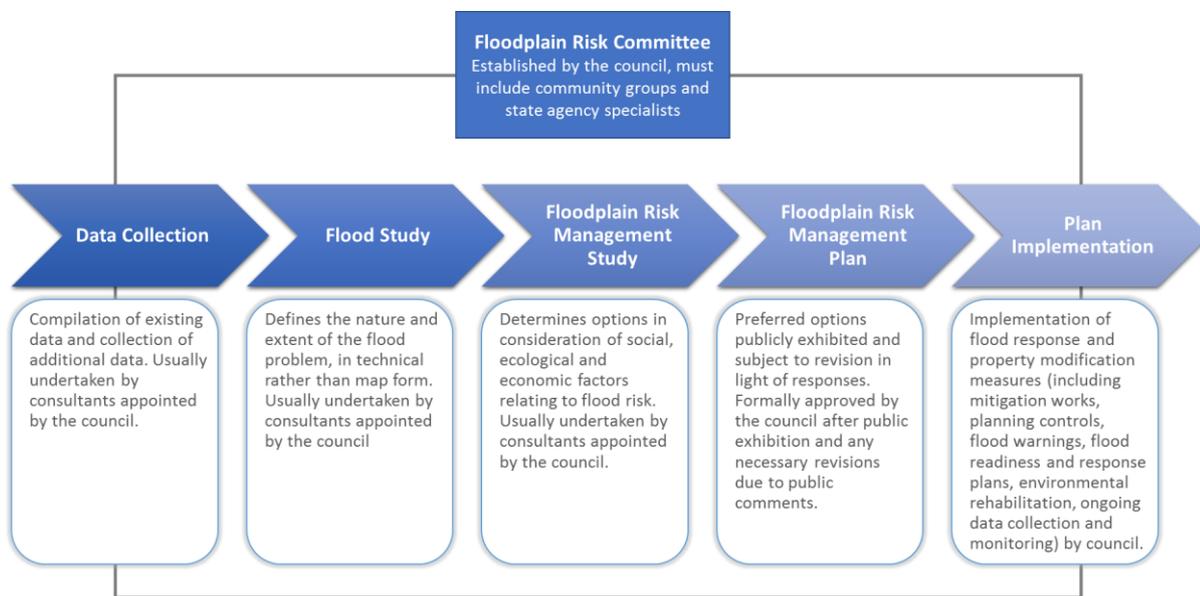
The primary objective of the New South Wales (NSW) Government’s Flood Prone Land Policy is to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible.

Through the NSW Department of Planning and Environment (DPE) and the NSW State Emergency Service (SES), the NSW Government provides specialist technical assistance to local government on all flooding, flood risk management, flood emergency management and land-use planning matters.

The Central Coast Council has prepared this document with financial assistance from the NSW Government through its Floodplain Management Program. This document does not necessarily represent the opinions of the NSW Government or DPE.

The *Floodplain Development Manual* (NSW Government, 2005) is provided to assist councils to meet their obligations through the preparation and implementation of floodplain risk management plans, through a staged process. **Figure F1**, taken from this manual, documents the process for plan preparation, implementation and review.

The *Floodplain Development Manual* (NSW Government, 2005) is consistent with Australian Emergency Management Handbook 7: *Managing the floodplain: best practice in flood risk management in Australia* (AEM Handbook 7) (AIDR 2017).



**Figure F1 The Floodplain Risk Management Process (source: NSW Government, 2005)**

Central Coast Council is responsible for local land use planning in its service area, including in the Woy Woy Peninsula. Through its Catchments to Coast Committee, Council has committed to prepare a comprehensive floodplain risk management plan for the study area in accordance with the NSW Government’s *Floodplain Development Manual* (2005). This document relates to the floodplain risk management plan phase of the process.

## Executive Summary

### Study Overview and Purpose

The Woy Woy Floodplain Risk Management Plan (FRMP) has been prepared for Central Coast Council (Council) in accordance with the New South Wales (NSW) Flood Prone Land Policy and the principles of the Floodplain Development Manual (NSW Government, 2005).

This FRMP is to be considered in conjunction with the Woy Woy Floodplain Risk Management Study (FRMS), and its associated Technical Volume and Appendices, prepared as a separate document to this FRMP. The FRMS (DHI, 2022), examined options for managing flood risk in the Woy Woy Peninsula. This FRMP outlines the floodplain management measures recommended as an outcome of the assessment undertaken in the FRMS along with the implementation strategy associated with those measures.

In addition to the FRMS, the following associated studies were undertaken on behalf Council for the purposes of preparing this FRMP:

- Woy Woy Climate Change Adaptation Study (Rhelm, 2021b) to identify feasible strategies to adapt the low-lying areas of Woy Woy to the impacts of sea level rise.
- Woy Woy Integrated Water Management Cycle and Case Study Everglades Catchment (DHI, 2021) to define flooding in this catchment utilising an integrated surface water and ground water model, and identify potential solutions to mitigate flooding.

The findings of these studies were also considered in the recommendations presented in this FRMP.

The overall objective of this Floodplain Risk Management Plan is to provide information for the management of flood risk into the future.

This FRMP outlines a range of measures to manage existing, future and residual risk effectively and efficiently. This document also presents a prioritised implementation strategy to guide the implementation of the proposed measures.

### Study Area

The Woy Woy Peninsula (the Peninsula) urban area is bounded by Brisbane Water to the north and east, Broken Bay to the south, and Brisbane Water National Park to the west.

The Peninsula, including the Kahibah Creek Catchment, is generally a flat sand-plain where ground levels typically vary between RL 2m to 6m (AHD). The remaining study area adjoins the National Park and Blackwall Mountain and is of higher elevation with rocky outcrops. The majority of the catchment is characterised by predominantly low-medium density urban development. The study area is approximately 18.5 km<sup>2</sup>.

### Flood Risk

The study area can be impacted by different mechanisms of flood risk, which can be characterised as follows:

- **Brisbane Water flooding as a result of ocean storms:**  
Ocean storm surge events result in the elevation of the Brisbane Water Estuary levels and can lead to flooding of the low-lying areas of Woy Woy, Blackwall, Booker Bay and Ettalong. During Brisbane Water flooding events, flood levels typically rise and fall over several hours, with inundation occurring for up to 5 hours in a 1% AEP event. Flood depths in lower lying areas can be up to 0.9 m at the peak of the 1% AEP flood event.

- **Local catchment flooding as a result of local rainfall:**

Catchment flooding occurs as a result of intense rainfall on the catchment, with the greatest modelled flood depths occurring as a result of a shorter duration storm events (typically one to six hours) for most design floods. This type of flooding is typical of the flat sand-plain central area that comprises about 90% of the Woy Woy Peninsula, which is partially mitigated by the infiltration of runoff into the highly permeable sandy soils beneath. However, high groundwater levels can reduce infiltration and sometimes exacerbate flooding in these lower areas. Flooding in the flatter areas is generally low-risk nuisance flooding associated with peak depths in roads and private property up to 0.3 m. High groundwater levels that can exacerbate surface flooding is found west of Ocean Beach Road near Ryans Road. Catchment flooding in areas with steeper gradients, such as the slopes of Blackwall Mountain and along the western escarpment, are associated with and less permeable soils and produce higher velocity runoff. Flooding of roads and private properties in these areas is usually accompanied by relatively greater flooding of roadways and property along drainage pathways and trapped low points with flood depths of up to 0.8 m at the peak of the 1% AEP flood event.
- **Tidal inundation during high tides:**

The existing flood risk associated with tidal inundation is low in comparison to the other mechanisms of flooding. However, it is expected that in the future, as a result of sea level rise, a large proportion of the study area will be subjected to relatively frequent inundation from high tides.

## Consultation

The community engagement strategy undertaken as part of this FRMS and FRMP includes the following components:

- Community newsletter and questionnaire
- Project website
- Publication of media releases
- Community information (drop-in) sessions
- Agency consultation
- Stakeholder meetings
- Public Exhibition.

The community and other stakeholders provided valuable insights about the flooding issues experienced in Woy Woy and how they could be addressed. The potential flood risk management measures identified and assessed as part of the FRMS addressed the reported issues, considering potential impacts, technical constraints, and the current understanding of the local flood behaviour.

A more detailed description of the community consultation strategy adopted in the FRMS and FRMP is provided in **Section 2.4** of this document.

## Floodplain Risk Management Study

The Woy Woy Floodplain Risk Management Study (DHI, 2022) provides a comprehensive evaluation of the flood risks in Woy Woy and identified potential options to mitigate these risks.

The key outcomes of the FRMS include:

- Engagement with the local community to gather historical and anecdotal flood information and provide an avenue for direct community involvement in the study.

- Evaluation of flood risk to the community based on the outcomes of a revised and calibrated flood model incorporating the effects of groundwater in the study area. This analysis included flood hazard and emergency response mapping, and economic damages assessments.
- Review of flood planning policy, including flood-related controls covered by the LEP, relevant DCPs, Council policies and plans. The recommendations proposed as an outcome of this review are presented in this FRMP.
- Identification of a range of flood mitigation measures to address existing and future flood risk and evaluation of these measures with the use of a Multi-Criteria Assessment (MCA) approach. The MCA enabled the comparative assessment of all options based on their economic, social, and environmental aspects, as well as on their effectiveness in mitigating flood risk.

This FRMP has drawn from the conclusions of the analysis undertaken in the FRMS and present the recommended measures for managing flood risk at Woy Woy, as well as the strategy to implement these measures.

### Climate Change Flood Risk and Planning

A climate change adaptation study was recently undertaken by Council (Rhelm, 2021b), which has informed this Plan; it focused on the technical analysis of a raised landform to provide flood protection against existing and future flood risk.

The proposed concept landform provided for fill to raise properties and infrastructure above defined flood and tidal levels, as well as being designed to improve runoff during rainfall events (current drainage issues are primarily associated with the flat terrain). Drainage and flood protection measures such as easements were also incorporated into the concept designs.

The findings of the climate change adaptation study (Rhelm, 2021b) are presented in **Section 3**.

### Recommended Floodplain Risk Management Measures and Implementation Program

The outcomes of the options analysis undertaken in the FRMS form the basis of this FRMP. A detailed description of the recommended floodplain risk management measures is provided in **Section 4.2**.

**Table E-1** summarises the recommended measures categorised by mitigation type (Flood Modification, Property Modification, and Emergency Response Modification).

**Table E-1 Summary of Recommended Floodplain Risk Management Measures**

Mitigation Type	Option ID	Option Name	Implementation Time Frame / Priority
<b>Flood Modification</b>	FM03	Installation of six infiltration devices along low lying streets with a history of ponding and nuisance flooding due to lack of drainage or drainage capacity	< 10 years / Medium
<b>Property Modification</b>	PM01	Land Use and Development Control Planning Recommendations	< 5 years / High
	PM05	Property Education and Compliance	< 5 years / Medium
	PM06	Sustainable Level of Drainage Service	< 10 years / Medium
	PM07	Landform Adaptation	< 10 years / High

Mitigation Type	Option ID	Option Name	Implementation Time Frame / Priority
<b>Emergency Response Modification</b>	EM01	SES Review of Evacuation Centre Locations	< 5 years / Medium
	EM03	SES Review of Flood Warning Systems	< 10 years / Low
	EM04	Flood Warning Signs	< 5 years / Medium
	EM05	Flood Education Programs	< 5 years / Medium

Priorities of each option are categorised as High, Medium and Low in the following manner:

- **High priority:**
  - Require relatively low implementation effort and cost AND achieved a high score in the MCA (overall rank higher than 5).
  - Essential for a future climate change adaptation plan to be implemented before sea level rise triggers are reached.
- **Medium Priority:**
  - Requires significant implementation effort and cost AND achieved a high score in the MCA (rank higher than 5).
  - Achieved a medium score in the MCA (overall rank higher than 10).
- **Low Priority:**
  - Achieved a relatively low score in the MCA (overall rank lower than 10).

To achieve the implementation of relevant management actions, a program of implementation has been developed. The proposed implementation strategy is presented in **Section 4.3**. The proposed program provides information on the estimated costs of each measure, the agency / organization responsible for the action, as well as the priority and time frame for implementation.

## Conclusions and Recommendations

This FRMP provides a practical framework and implementation plan for managing existing, future and continuing flood risk within the study area.

Overall, it is considered that existing flood risks to Woy Woy can be managed appropriately through the implementation of development controls, emergency response measures and selected ground works. The effective implementation of development controls will be of key importance in reducing the damages and risk to life associated with flooding into the future through the construction of flood compatible buildings and assets.

This FRMP fulfills its objectives in accordance with the NSW Flood Prone Land Policy (NSW Government, 2001) and the principles of the Floodplain Development Manual (NSW Government, 2005).