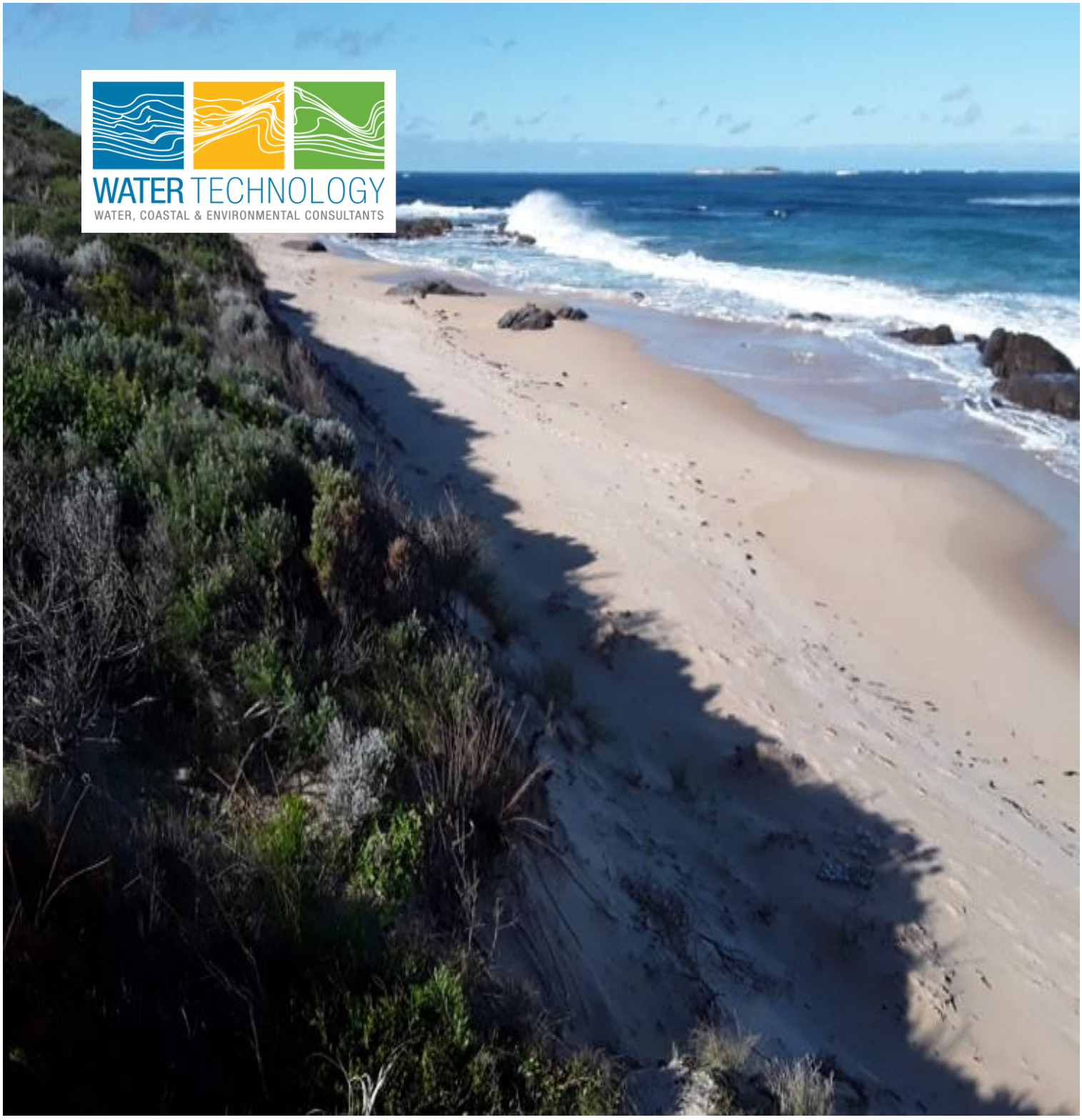

Coastal Hazard Risk Management and Adaptation Plan

Windy Harbour CHRMAP

Shire of Manjimup

14 February 2025

Document Status

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ACKNOWLEDGEMENT OF COUNTRY

The Board and employees of Water Technology acknowledge and respect the Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of Country throughout Australia. We specifically acknowledge the Traditional Custodians of the land on which our offices reside and where we undertake our work.

We respect the knowledge, skills and lived experiences of Aboriginal and Torres Strait Islander Peoples, who we continue to learn from and collaborate with. We also extend our respect to all First Nations Peoples, their cultures and to their Elders, past and present.

Artwork by Maurice Goolagong 2023. This piece was commissioned by Water Technology and visualises the important connections we have to water, and the cultural significance of journeys taken by traditional custodians of our land to meeting places, where communities connect with each other around waterways.

The symbolism in the artwork includes:

- *Seven circles representing each of the States and Territories in Australia where we do our work*
- *Blue dots between each circle representing the waterways that connect us*
- *The animals that rely on healthy waterways for their home*
- *Black and white dots representing all the different communities that we visit in our work*
- *Hands that are for the people we help on our journey*

EXECUTIVE SUMMARY

The Western Australian Planning Commission's "State Planning Policy No. 2.6: State Coastal Planning Policy" (WAPC, 2013, herein referred to as "SPP2.6") addresses climate change, sea level rise, increased coastal inundation (temporary coastal flooding), and coastal erosion. SPP2.6 recommends that management authorities develop a Coastal Hazard Risk Management and Adaptation Plan (CHRMAP) for land use or development vulnerable to coastal hazards. Specific CHRMAP Guidelines have been developed to assist this process (WAPC, 2019).

Part of the Windy Harbour settlement has been identified as potentially exposed to erosion hazards. This coastal hazard risk was a key trigger for the requirement of this CHRMAP. Therefore, the study aimed to investigate and plan for coastal hazards likely to affect Windy Harbour. This project is funded by the Western Australian Planning Commission through the Coastal Management Plan Assistance Program.

This CHRMAP increases knowledge and understanding of coastal hazard risks and identifies risk management and adaptation measures for implementation. The outcomes will be used to inform local government policies, strategies and plans, including (but not limited to) planning strategies, community strategic plans, drainage strategies, asset management plans, and foreshore management plans. The project adhered to the WAPC (2019) guidelines with scope and deliverables consistent with their objectives and SPP2.6. In addition, the project has identified the strategic direction for coastal adaptation scenarios from the present to 2122 (100-year management time frame) and determined an implementation plan describing risk management measures to be undertaken to achieve this direction. Overall, this CHRMAP has developed flexible adaptation pathways for the Shire of Manjimup and will serve as a key reference for management, planning and policymaking for the short-term (0-15 years), medium-term (15-30 years), and long-term (100 years).

The Windy Harbour shoreline was divided into four management units (MUs):

- MU1 - Cathedral Rocks to lookout staircase
- MU2 - Lookout staircase to the boat ramp
- MU3 - Boat ramp to Fisherman's Place access track
- MU4 - Fisherman's Place access track to Windy Harbour limit

A Coastal Hazard Assessment identified the coastal hazards in the study area that need to be considered in the CHRMAP. Hazard maps were produced defining the erosion and inundation extents for the present day, 2032, 2052, 2072, 2092 and 2122. It is acknowledged that the hazard identification component of the present study was undertaken to provide a broad understanding of exposure to the Shire of Manjimup for the purpose of informing local government policies, strategies and plans. Further planning and development will require more detailed risk assessments and detailed engineering measures. Erosion response across the study area may differ from this study's predictions.

Following the Hazard Assessment, a Coastal Assets and Community Values Identification investigation was undertaken to identify the assets within the coastal hazard zone. All the assets in the coastal hazard zone were identified and classified into five categories: public infrastructure, recreational, lease cottages and camping ground, environmental, and heritage. The quantity of each asset category by Management Unit, category and planning horizon are presented for erosion hazard. Inundation has been shown to be insignificant for the study area.

Community and stakeholder involvement is a critical component of the CHRMAP process, as it defines what and how much value is placed on assets within the study area. Community Engagement outcomes have informed the adaptation planning process. A Community Values assessment was used to identify key values and concerns for the study area to identify appropriate success criteria for the project:

- Enjoying natural landscapes that are not interrupted by human-made structures

- Conserve heritage sites
- Ensuring that site-appropriate foreshore facilities are provided and maintained
- Ensure access and quality of natural beaches and foreshore reserves for use by current and future generations where possible
- Maintain recreational activities for the community
- Using the coast for commercial operations that support the local economy
- Experience the coastal landscape through infrastructure designed to enhance enjoyment
- Maximise the experience and services that are available to leaseholders and visitors alike
- Provide good governance, with the CHRMAP objectives being understood and supported by the Shire of Manjimup and its elected members, stakeholders and the community

A Vulnerability Analysis was undertaken to develop likelihood, consequence, level of risk, adaptive capacity and vulnerability ratings for the five asset categories. All identified at-risk assets within the management units are presented for each of the planning horizons. Extreme vulnerability to erosion has been identified from the present day onwards across all MUs for some categories – increasing over the 100-year project timeframe.

Recommended adaptation options to manage the coastal erosion vulnerability are presented to give direction for future investigations and funding opportunities. The recommendations are based on currently available information and will require preliminary preparatory work before being implemented. Depending on implementation option, the preliminary preparatory work may encompass

The study found that the preferred approach to address erosion has been a **combination of Planned / Managed Retreat and Protection with Beach Renourishment**. Several additional investigations have been recommended:

- Preparation of Asset Management Plans.
- Investigate opportunities for demarcating a Special Control Area and introducing development restrictions.
- Heritage Investigation.
- Sand source feasibility study.
- Preparation of a Foreshore Management Plan.
- Community education.

The CHRMAP is a strategic planning document that considers long timeframes. While the CHRMAP provides a rationale for coastal hazard management, a substantial amount of preparatory work, detailed in the CHRMAP recommendations, is required before “on-the-ground implementation” can proceed.

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1 INTRODUCTION

1.1 Background

It is internationally recognised that the mean sea level has been rising globally since the nineteenth century and is predicted to rise at an increasing rate in the future (IPCC 2021). Rising sea levels and intensifying storm activity will increase the risk of coastal inundation (temporary coastal flooding), storm erosion and long-term shoreline recession. Australia's State governments have introduced obligations requiring local governments to consider and plan for these hazards. In Western Australia (WA), the governing policy is the Western Australian Planning Commission's (WAPC) State Planning Policy No. 2.6: State Coastal Planning Policy (WAPC, 2013, herein referred to as "SPP2.6"). SPP2.6 recommends that management authorities develop a **Coastal Hazard Risk Management and Adaptation Plan (CHRMAP)** for land use or development that is potentially vulnerable to coastal hazards. Specific guidelines have been developed to assist in this process (WAPC, 2019).

SPP2.6 requires adequate risk management planning is undertaken where existing or proposed development is in an area at risk of being affected by coastal hazards over the 100-year planning timeframe. SPP2.6 and the CHRMAP Guidelines provide the risk assessment framework to be applied to identify risks that are intolerable to the community and other stakeholders, such as local governments, indigenous and cultural interests, and private enterprises. Risk management measures are then developed according to the adaptation hierarchy outlined in SPP2.6.

Windy Harbour has been identified as a projected erosion hotspot within 25 years in Western Australia (Seashore Engineering, 2019) and is located approximately 27 km south of Northcliffe within the Shire of Manjimup. The Shire comprises a stretch of sandy coast on the eastern side of Point' D'Entrecasteaux and includes recreational camping, a caravan park, and holiday cottages. As a result, the Shire has initiated the development of a CHRMAP, which will identify the coastal hazards in the area and corresponding at-risk assets and community values, see Figure 1-1 for the study area.

This CHRMAP project aims to increase knowledge and understanding of coastal hazard risks and identify risk management and adaptation measures for implementation. The outcomes will be used to inform the Windy Harbour Management Plan, local government policies, strategies and plans, including (but not limited to), planning strategies, community strategic plans, drainage strategies, asset management plans, emergency management plans, and foreshore management plans.

The project has adhered to the WAPC (2019) guidelines with scope and deliverables consistent with their objectives and SPP2.6 and follows the risk management and adaptation hierarchy of 'Avoid', 'Retreat', 'Accommodate' and 'Protect'. In addition, the project determines the strategic direction for coastal adaptation scenarios from the present day to 100 years into the future and identifies an implementation plan to achieve this direction. Overall, this CHRMAP has developed a flexible adaptation pathway for the area and serves as a key reference for management, planning, and policymaking in the short-term (0-15 years), medium-term (15-30 years), and long-term (100 years).

Delivery of this project has occurred over 8 stages (as summarised in Figure 1-3), each representing a key hold point. Each stage was developed according to the Shire of Manjimup scope and is in line with the CHRMAP Guidelines (WAPC, 2019). This report presents Stage 8: CHRMAP Summary Document. This report presents the CHRMAP project summary and recommends addressing erosion and inundation vulnerabilities. The red bubble in Figure 1-3 indicates where this report sits in the CHRMAP methodology.

Figure 1-1 Study Area

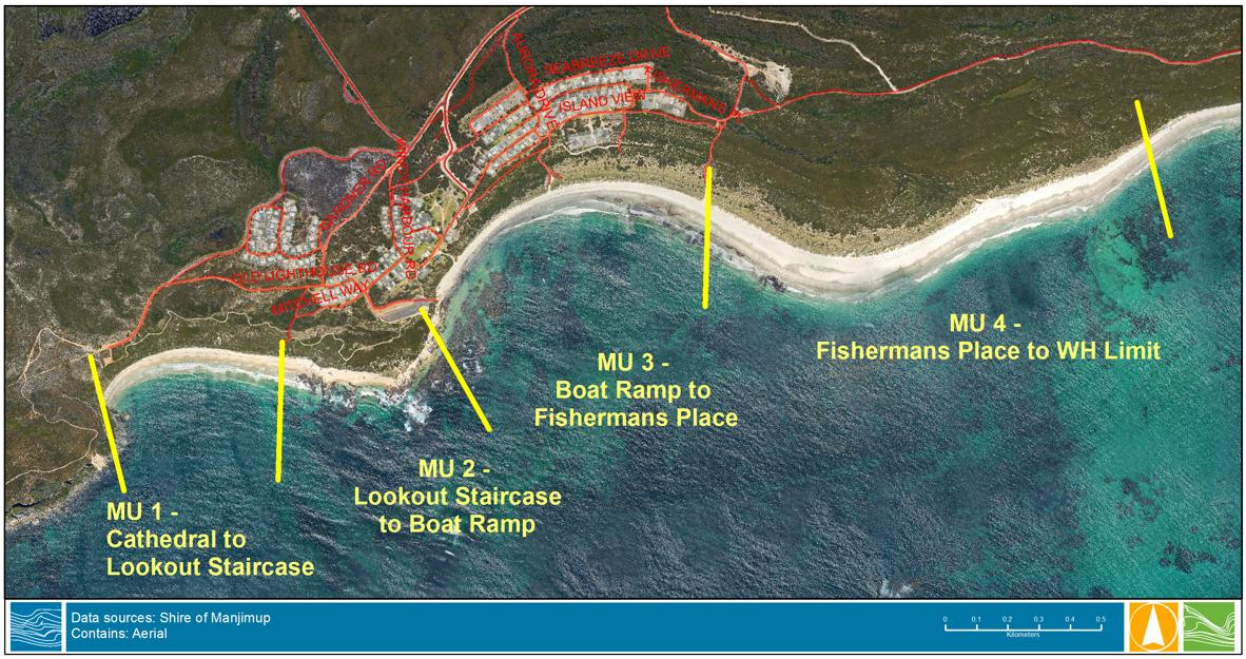

Figure 1-2 Management Units for Windy Harbour

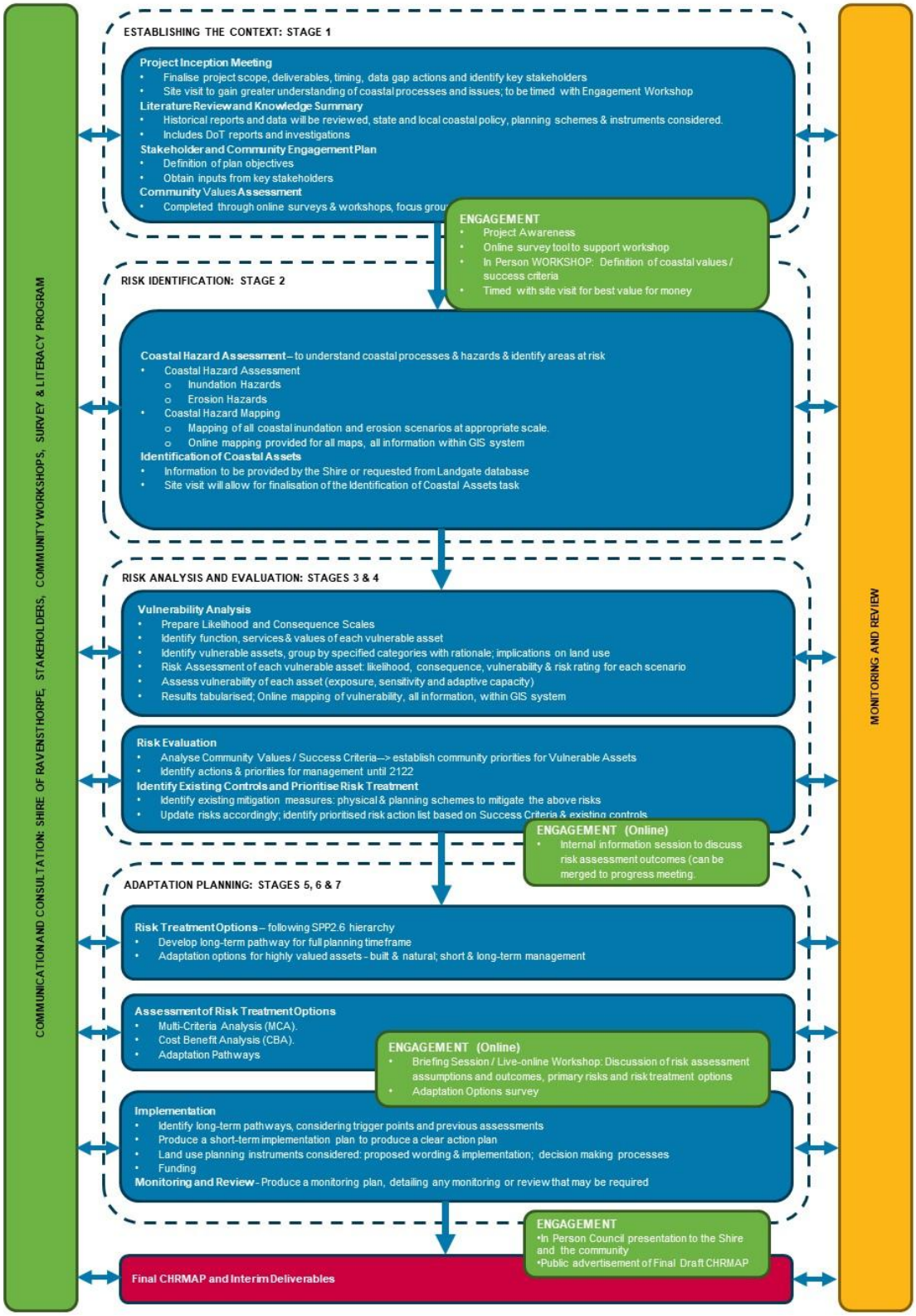

Figure 1-3 CHRMAP methodology

1.2 Structure of this report

This report is a summary document outlining the CHRMAP project and presenting content from the previous project stages and technical chapter reports. It has been written to provide an overview that is more accessible to a wider audience. This report addresses coastal hazard vulnerabilities for the Shire and should be considered in combination with the more detailed technical reports provided in the appendices. References are provided throughout this document, and the documents are listed in the reference section of the relevant technical reports.

To facilitate the coastal hazard assessment and development of adaptation options, the study area was delineated into several management units, refer Figure 1-2, , which are determined according to a set of factors:

-
- Presence of coastal assets and relevant stakeholders
- Shoreline orientation
- Natural and manmade shoreline features, such as extended shoreline hardening (e.g. seawalls), Points established by geological features and/or localised sediment transport regimes, and
- Coastal processes and potential hazard types.

The study area shoreline was divided into four management units:

- MU1 - Cathedral Rocks to the lookout staircase
- MU2 - Lookout staircase to the boat ramp
- MU3 - Boat ramp to Fisherman’s Place access track
- MU4 - Fisherman’s Place access track to Windy Harbour limit

2 ESTABLISH THE CONTEXT

An Establish the Context Chapter Report was prepared (Appendix A). This report outlines in detail the key management and adaptation issues that need to be considered in the CHRMAP, summarised below.

2.1 Purpose

This project aimed to prepare a Coastal Hazard Risk Management and Adaptation Plan (CHRMAP) for the Windy Harbour study area.

The CHRMAP sets the assessment framework by identifying coastal hazards, analysing vulnerability for specific assets, identifying and prioritising management and adaptation responses, and providing an implementation plan. It informs the community and stakeholders about potential coastal hazard risks, identifies community and stakeholders' values and key coastal infrastructure and assets at risk, and provides a clear pathway for the Shire to address coastal hazard risks over time. Ultimately, the CHRMAP provides strategic guidance for coordinated, integrated, sustainable land use planning and management decision-making. The CHRMAP also guides necessary changes to the Local Planning Scheme, other relevant strategies, and local planning policies.

2.2 Objectives

The overall objectives of this CHRMAP were to:

- Improve understanding of coastal features, processes and hazards in the study area,
- Identify significant vulnerability trigger points and respective timeframes for the relevant sediment cells to mark the need for immediate or medium-term risk management measures,
- Identify assets (natural and built) and the services and functions they provide situated in the coastal zone,
- Gain an understanding of assets' vulnerability,
- Identify the value of the assets that are vulnerable to adverse impacts from coastal hazards,
- Determine the consequence and likelihood of coastal hazards on the assets and assign a level of risk,
- Identify possible (effective) risk management measures (or 'actions') and how these can be incorporated into short and longer-term decision-making and
- Engage stakeholders and the community in the planning and decision-making process.

2.3 Scope

The CHRMAP identifies assets and values at high risk from coastal erosion and flooding in the study area. It proposes risk management measures to reduce these risks to acceptable levels, focusing on short-term actions and providing strategic guidance for medium and long-term measures. The CHRMAP has focussed on preserving assets and values that provide public benefit, although other at-risk assets have also been identified. This is achieved by following the process as outlined in Figure 2-1.

A project Steering Committee was established to oversee the preparation of the CHRMAP and provide technical coastal and planning skills to the Shire of Manjimup. The members consist of representatives of the Shire of Manjimup, the Department of Planning Lands and Heritage (DPLH), Department of Transport (DoT) and the community.

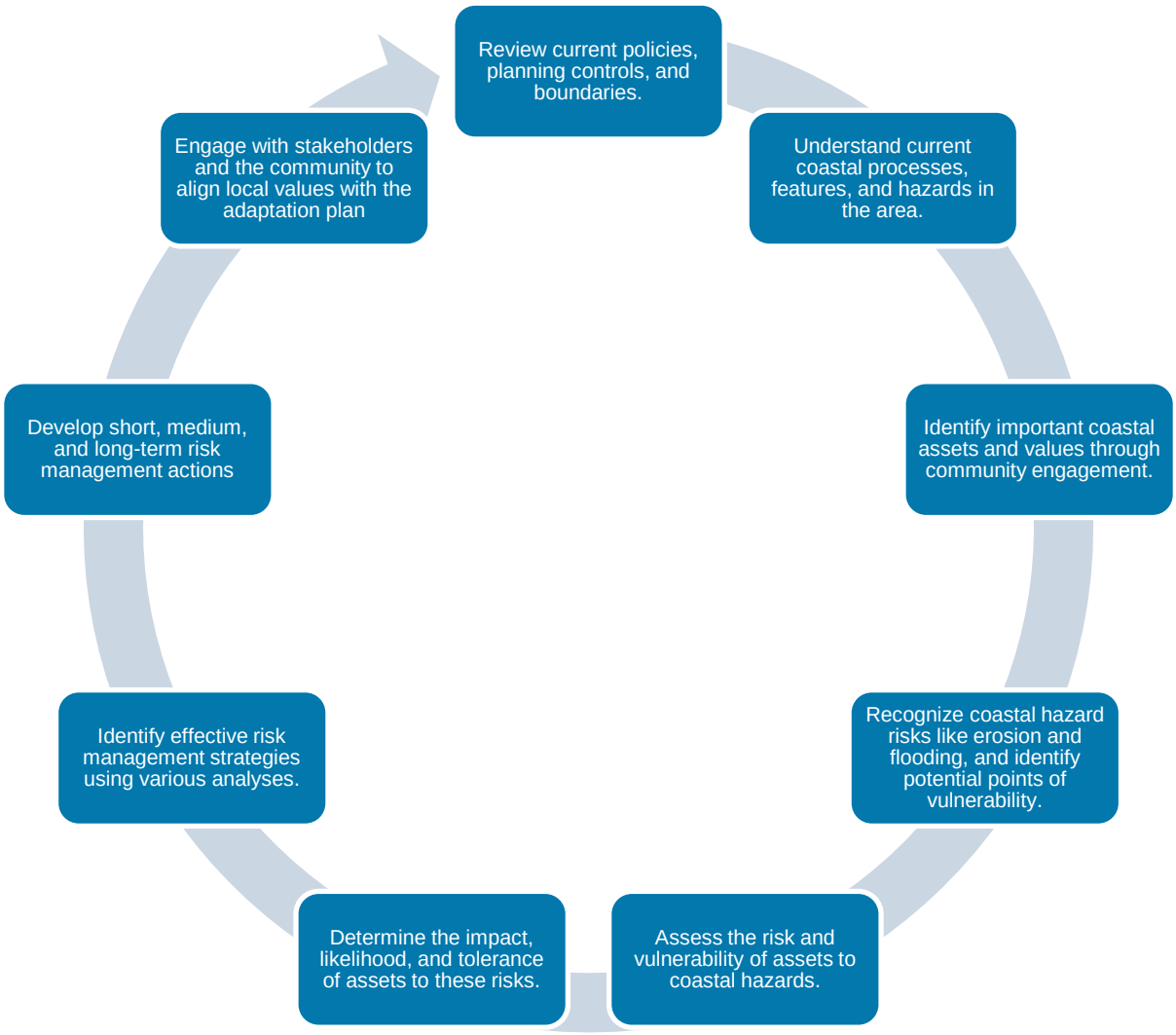

Figure 2-1 CHRMAP process

2.4 Local Context

The study comprises approximately 3.5kms of coastline associated with the Windy Harbour Settlement and is located on an “A Class Reserve” within the D’Entrecasteaux National Park that is vested with the Shire for the purposes of Recreation Camping, Caravan Park and Holiday Cottages.

The Windy Harbour coastline is visited by resident cottage leaseholders and visitors alike, with beaches popular for swimming and sunbathing. The adjacent foreshore supports a variety of recreational uses and includes public-built infrastructure close to the shoreline. Such infrastructure may be subject to the impacts of coastal hazards in the future and includes the Marine Rescue building, caretaker residence and associated Shire infrastructure, playground, footpaths, roads and car parks, toilet block, campground and lease cottages.

There are 225 Cottage Leases and 7 Professional Fisherman leases within the settlement. The boat ramp has an important search and rescue function as the only formal boat ramp between Augusta and Walpole. The Department of Transport Western Australia has identified the location as a projected erosion hotspot within 25 years and is considered a priority for coastal hazard risk management and adaptation planning. Windy Harbour is not considered a hotspot for coastal inundation. Previous incidents of temporary freshwater flooding are understood to be caused by drainage issues and heavy rainfall. Nonetheless, the stormwater drainage outlet flows to the beach and may be impacted by high tides.

The shoreline includes granite and limestone headlands, outcrops and reefs, providing some protection from wave energy impacting the remaining white sandy beach shoreline sections. The location's primary landforms consist of mixed sandy and rocky coasts, low foredunes, and high primary dune systems. Coastal infrastructure includes the boat ramp and associated infrastructure such as the car park and amenities block and beach access paths, boardwalks and staircases. The study area faces generally south into the Southern Ocean and is exposed to persistent moderate to high southerly swell and periodic strong south through west winds. A series of nearshore reefs and islands afford this exposed coast some shelter. Site observations indicate the site experiences a varied wave climate, which includes significant wave energy during storm events.

Longshore sediment transport is not well-documented in the study area. Based on site visit observations cross-shore sediment movement is observed to be seasonal, with winter storms eroding the beach face and redepositing sediment to form offshore sandbars. These formations are likely to become stable towards the end of winter and act as a buffer, preventing wave breaking at the shore. Detailed assessment of sediment transport sources, sinks and pathways is unavailable.

2.5 Existing Planning Policies and Strategies

Planning in Western Australia is guided and regulated by the State Planning Framework, which ranges from overarching strategic planning strategies to specific planning policies and supportive guidelines. Figure 2-2 explains the framework, which includes planning at the state, regional, and local levels and demonstrates how strategic planning is implemented through statutory planning controls (e.g., local planning schemes) and local planning policies. This Framework sits within the Planning and Development Act 2005. The relationships of the various policies are presented in Figure 2-3.

The planning documents within this Framework were reviewed to determine which are relevant to coastal hazard planning in the project area. This review helped to assess the adequacy of the existing planning documents for addressing coastal hazards, identify gaps that needed to be addressed through the CHRMAP process (such as planning controls that are required or need amending to enable implementation of CHRMAP recommendations), identify any potential planning issues that may constrain the CHRMAP process; and ensured that the adaptation plan aligns with state, regional and local planning frameworks.

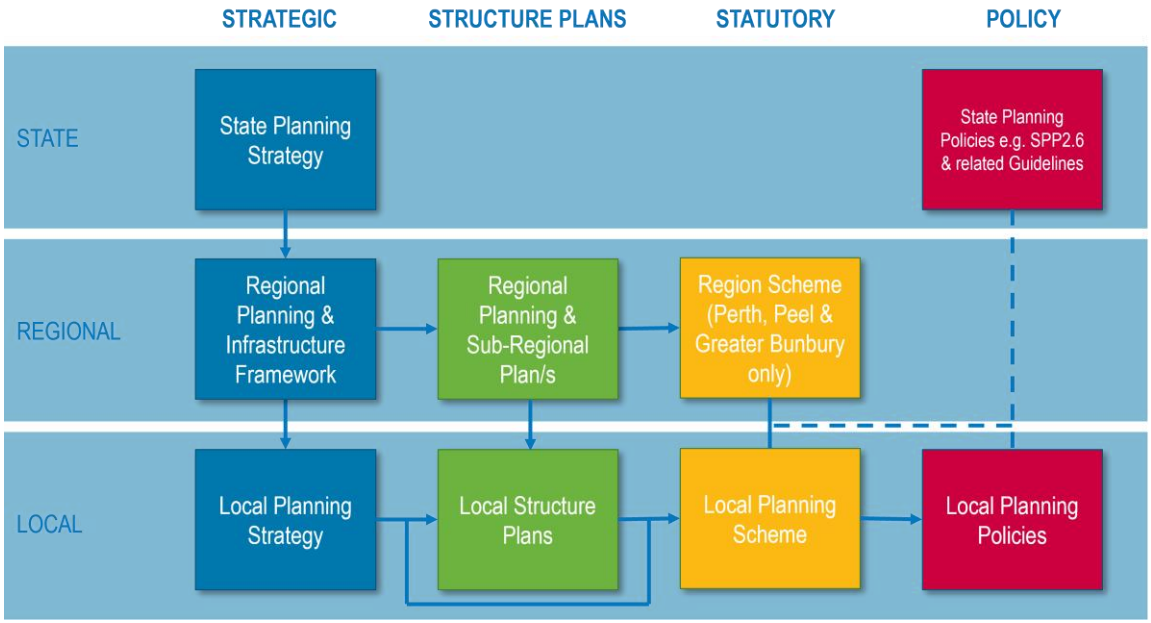

Figure 2-2 State Planning Framework for Western Australia

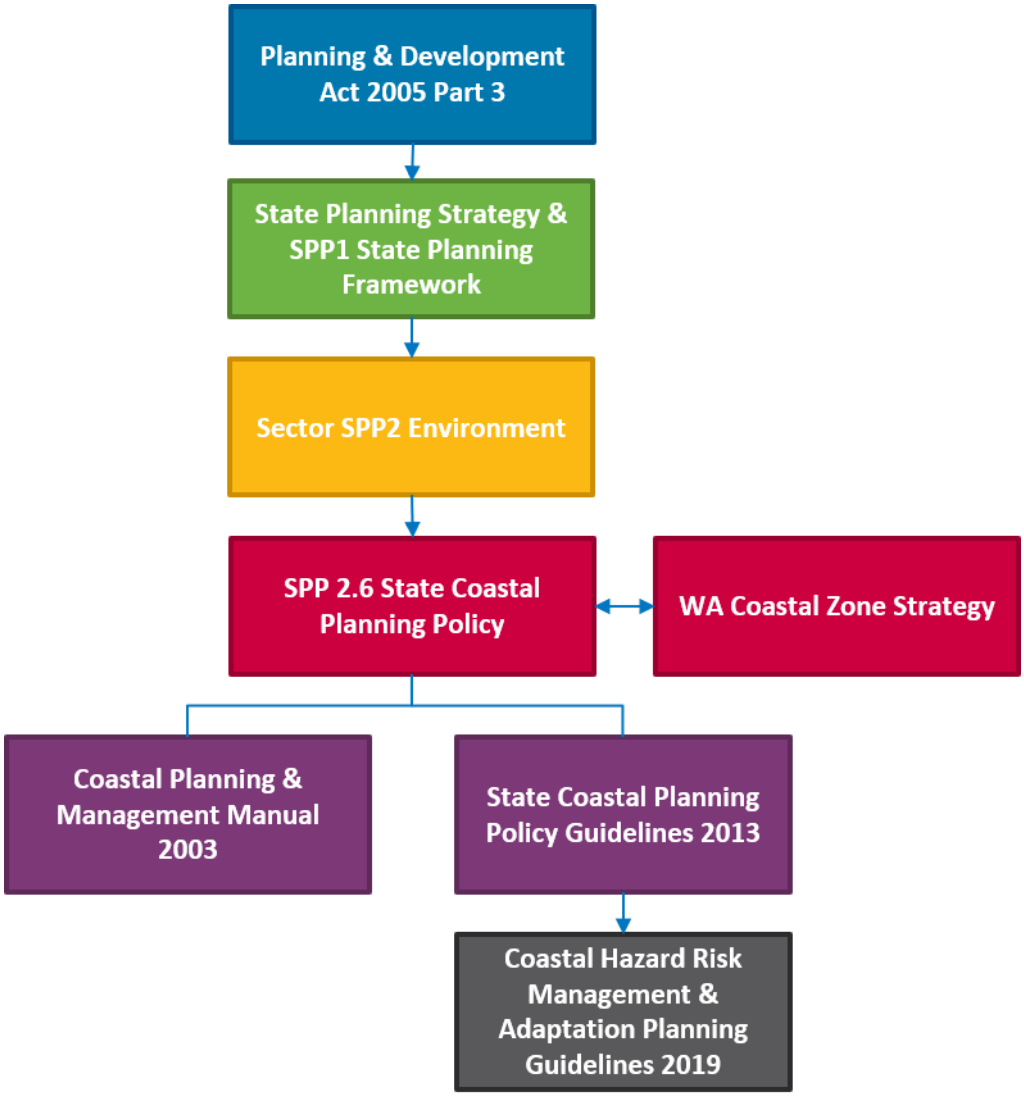

Figure 2-3 Policy Relationships

A summary of information from the planning documents relevant to the coast is included in Table 2-1 below. Information relevant to the CHRMAP has been included below and is discussed further in the Establish the Context Report (Appendix A). For context, Windy Harbour is a special usage area. The current purpose of Reserve 38881 is 'Recreation, Camping, Caravan Park, and Holiday Cottages'. Presently, no location-specific coastal hazard controls are in place in the study area.

Table 2-1 Summary of relevant planning framework

Framework function	Document	Purpose
Relevant Planning Legislation	Planning and Development (Local Planning Schemes) Regulations 2015	Regulations were introduced by the State government to ensure a consistent structure, format and approach to local planning schemes and planning mechanisms across the state of Western Australia.
State Planning Framework	WA Coastal Zone Strategy	Integrated framework for collective action to manage and adapt to threats and pressures along the coast. The fundamental aim of this strategy is to ensure that coastal development is sustainable in the long term and meets community, economic, environmental and cultural needs.
State Planning Framework	State Planning Policy 2.6: State Coastal Planning Policy and Guidelines	Guides decision making in relation to planning along the state's coastline and stipulates the requirements for the preparation of this CHRMAP.
State Planning Framework	Coastal hazard risk management and adaptation planning guidelines	Guide for decision-makers to develop and implement effective coastal hazard risk management and adaptation plans.
State Planning Framework	State Planning Policy 3.4: Natural Hazards and Disasters	Guide to ensure that land use planning appropriately considers the risk of natural hazards and disasters.
State Planning Framework	South West Regional Planning & Infrastructure Framework (2015)	Provides a regional context for land use planning and identifies priority actions
Local Framework	Augusta-Walpole Coastal Strategy (2009)	Guides how various issues affecting the coast in this area can be managed
Local Framework	Local Planning Strategy (2003)	Acknowledges that the Windy Harbour Management Plan 1999 had been adopted by the Shire.
Local Planning Framework	Shire of Manjimup Local Planning Scheme No. 4	Defines the zoning with the "Special usage area" for Windy Harbour
Local Planning Framework	Windy Harbour Management Plan 2007 – 2017	Determines spatial arrangement and land uses within Windy Harbour
Local Planning Framework	Local Planning Policies	Outlines procedures, land uses, development requirements and design guidelines for a variety of matters.

2.6 Community and Stakeholder Engagement

Key to the success of the CHRMAP project was to ensure that the adaptation plan was underpinned by community and stakeholder values and knowledge. To this end, a Community and Stakeholder Engagement Plan was developed to identify relevant stakeholders and determine the structure and pathways for their engagement throughout the CHRMAP process. The plan was designed to be fit for purpose and

commensurate with the size and scope of the CHRMAP – to avoid consultation fatigue within the community. This plan was prepared following the requirements of, and for consistency with, the International Association of Public Participation (IAP2) documentation. A summary of the resultant engagement activities, participation and findings is presented in Table 2-2.

Table 2-2 Summary of engagement activities

Activity	Timing & Participants	Key Finding
Coastal assets and values workshop	June 2022 9	▪ The boat ramp was identified as a key asset to the settlement – its use for recreational fishing and usability/safety in general. ▪ The settlement is primarily used for recreation – summer family holidays, recreational fishing, easy access to the beach and foreshore in good condition, walking, four-wheel driving, swimming, and general recreation. ▪ Camping ground – and amenities, including power supply ▪ Marine Rescue building precinct – boating safety and also used as an evacuation zone during bushfires in recent years ▪ Shire buildings and infrastructure – roads, buildings, water supply, single underground stormwater drain – There was a request to confirm water standpipes through settlement are mapped, and review confirms the Shire holds this information ▪ The desire for CHRMAP to help identify land in the study area that is suitable for future development ▪ Concerns about how CHRMAP outputs will be used to inform an update of the Windy Harbour Management Plan
Community engagement by Shire of Manjimup	May 2022	▪ Leaseholders received written advice informing them of the project and how they could contribute
Coastal values survey	August 2022 58	▪ The coastal zone is important to respondents, and the loss of the experiences/opportunities in the area would significantly impact their way of life. ▪ Survey responses indicated that the beaches and boat ramp areas are valued almost equally for activities both on water and land. ▪ Regarding coastal erosion and inundation, more than 70% observed erosion events, primarily associated with storms, with the observed replenishment of the sand eventually. ▪ Most spontaneous comments highlighted that they trust nature and would prefer to maintain everything without intervention to preserve the natural environment. ▪ The results of the survey, in combination with the outputs from the workshop, have informed the identification of assets and values.

Activity	Timing & Participants	Key Finding
Community engagement workshop	February 2024 10	▪ Managed Retreat – natural coastline considered important. Protection measures are not considered to be able to withstand coastal pressures. All areas are preferred to have sand nourishment as a protection measure over rocks and groynes if needed. ▪ Government owners of vulnerable assets should pay for coastal adaptation and management. ▪ Coastline is very dynamic; it is probably very hard to mitigate against seasonal winter storms. ▪ Managing the boat ramp and car parking areas is important to allow for the large numbers that now use and the increase in usage likely to occur. ▪ The current staircase and trail access is inadequate. ▪ Sand and seaweed currently being removed from the boat ramp could be pushed out to sea to feed fish, used to reinforce the sand dune behind the Caretaker's cottage, or it could be stored in the car park for later use rather than near the informal parking area on the beach where tractors park as it gets waterlogged and dangerous to drive/walk on. ▪ The preferred adaptation pathway for MU1, MU2 and MU4 is Planned / Managed Retreat, and for MU3 it is Protect.
Adaptation options survey	February & March 2024 18	▪ The majority valued the area around the boat ramp most (even a split of responses between MU2 and MU3). ▪ There was support for the following management pathways: 1. Retaining public access to beaches and foreshore reserves 2. Dune and foreshore preservation 3. Managed retreat of assets away from the coast 4. Disallowing more intensive development in hazard areas 5. Informing landholders about erosion risk when buying or developing 6. Allowing the protection of private property/assets where this would have no impact on the surrounding coastline. ▪ Less than half of respondents (between 31% and 50%) were willing to pay something to continue to provide any of the following: sandy beach, natural foreshore, fund coastal protection, and beach stairs adaptation. Of those willing to pay, the majority opted for $100/year, though many opted for less than this. ▪ Across all 4 sections of the coast, the most popular response was for planning to be amended to limit future coastline development and plan for relocation/retreat (between 63% and 69%). ▪ Many supported dune conservation to continue (44-56%), and in MU 2 and MU 3 (surrounding the boat ramp), 56% of respondents wanted beach access and other facilities to be constructed/maintained.
Onsite briefing session by Shire of Manjimup	March 2024 9	▪ Onsite briefing of hazard mitigation pathways, and collecting community preferences

Activity	Timing & Participants	Key Finding
Draft CHRMAP	2024 N/A	Draft CHRMAP will be placed on the CHRMAP website for public comment.

2.7 Success Criteria

The values collated from the engagement were used to generate the success criteria for the CHRMAP. These values are key to the whole CHRMAP and help drive the selection of adaptation options. The success criteria are:

- Enjoying natural landscapes that are not interrupted by human-made structures
- Conserve heritage sites
- Ensuring that site-appropriate foreshore facilities are provided and maintained
- Where possible, provide access and quality of natural beaches and foreshore reserves for use by current and future generations.
- Maintain recreational activities for the community.
- Using the coast for commercial operations that support the local economy
- Experience the coastal landscape through infrastructure designed to enhance enjoyment
- Maximise the experience and services that are available to leaseholders and visitors alike
- Provide good governance, with the CHRMAP objectives being understood and supported by the Shire of Manjimup and its elected members, stakeholders and the community

3 RISK IDENTIFICATION

A Risk Identification Chapter Report (Appendix B) was prepared to identify the coastal hazards in the study area that need to be considered in the CHRMAP. Hazard maps were produced defining the erosion and inundation extents present day, 2032, 2052, 2072, 2092, 2122.

In the context of this CHRMAP, GB Geotechnics (GBG) under DoT supervision carried out a Geophysical Survey in May-June 2022. The investigation considered the Management Unit 3 – boat ramp to Fisherman's Place. The survey involved geophysical investigation and intrusive geotechnical testing. The investigation did not identify rock resistant to erosion at sufficient elevation to reduce the projected hazard areas. This information was considered in classification of the coast and subsequently in erosion hazard mapping.

A key policy objective of SPP2.6 is the provision of a coastal foreshore reserve. The coastal foreshore reserve is a 'space' between the ocean and developed land. It should accommodate a range of functions and values, such as geomorphological integrity, biodiversity, heritage, public ownership, and access. The component of the coastal foreshore reserve that allows for coastal processes should be sufficient to mitigate the risks of coastal hazards by allowing for landform stability, natural variability, and climate change. The coastal foreshore reserve is a critical input into the coastal hazard risk management and adaption planning framework outlined in SPP 2.6. The assessment considers parallel allowances for coastal erosion and storm surge inundation.

The study area's coastline features a mixture of sandy and mixed sandy and rocky coasts as defined in SPP2.6. It is acknowledged that the hazard identification component of the present study was undertaken to provide a broad understanding of exposure to the Shire of Manjimup for the purpose of informing local government policies, strategies and plans. Further planning and development will require more detailed risk assessments and detailed engineering measures. Erosion response across the study area may differ from this study's predictions. Further investigations are recommended for this CHRMAP., and are found in Section 7.5.

3.1 Erosion Hazard Assessment Method

A desktop review of available information was undertaken, including:

- Metocean conditions,
- Coastal processes,
- Existing coastal monitoring and management, and
- Existing coastal hazard information.

The coastal hazard identification approach was developed based on the following policies and guidelines:

- State Planning Policy 2.6 State Coastal Planning Policy (SPP2.6) provides a clear method for evaluating hazards in tidal areas.
- Coastal Hazard Risk Management and Adaptation Planning Guidelines (CHRMAP Guidelines; WAPC, 2019).

SPP2.6 stipulates the following components be considered when evaluating the coastal erosion risk:

- Storm erosion in response to storm waves and loss of beach material.
- Historic shoreline movement that highlights the chronic/long-term evolution of the coast. Littoral drift processes, larger scale morphological movements, long-term water level/wave dynamic variations and climate change impacts could contribute to this.
- Direct response to future sea level rise.

SPP2.6 indicates the methods for determining the allowance for erosion for a sandy open coastline. The standard method from SPP2.6 was used, which considers erosion allowances relative to the present Horizontal

Shoreline Datum (HSD). The HSD is defined as the active limit of the shoreline under storm activity. It is the line from which the erosion hazard allowance is applied. In this assessment, HSD was determined by the elevation of the 100-year ARI Peak Steady Water Level. Based on the available measured tide received from DOT, relevant nearby sites for Windy Harbour are identified as Albany, Bremer Bay, Esperance, and Bunbury. Comparing water levels in these four locations with short-term measured water level data in Windy Harbour, Albany is identified as a comparable site for Windy Harbour water level variations, following the same observation, and based on Table 2.2, HSD is estimated as 1.1 m AHD.

The erosion hazard study followed sequence:

- Classification of the coast as Mixed Sandy and Rocky, or Sandy coast.
- Identify HSD.
- Simulate storm erosion for the 100-year ARI storm (S1).
- Allowance for the current risk of storm erosion (S1) estimated by SBEACH numerical model.
- Evaluate historic shoreline movement trends based on historic vegetation lines (S2).
- Evaluate the impacts of rising sea levels on the project timeframes (S3).
- Calculation of the uncertainty allowance as per SPP2.6
- Evaluate total erosion values for each coastal management zone and project timeframes.
- Mapping of erosion hazard lines defined by HSD+S1+S2+S3+uncertainty

3.2 Inundation Hazard Method

SPP2.6 requires the allowance for inundation to be the maximum extent of inundation calculated as the sum of extreme storm inundation (S4) plus the predicted extent of sea level rise at 2122.

The allowance for the extent of coastal inundation has been calculated as the maximum extent of storm inundation during the 500-year average recurrence interval (ARI) storm event. This was defined as the peak steady water level calculated based on analysis of available measured water level data, plus an allowance for wave set-up and runup components calculated by the Stockdon et al. 2006 formula.

Inundation extent is mapped through a “bathtub” model, which is a simplified approach to evaluate coastal inundation based on storm tide impact. The mapped inundation extents were reviewed to exclude any low-lying inland area not connected to the ocean.

3.3 Hazard Results

A key outcome of the coastal hazard assessment was the confirmation that coastal erosion is potentially a significant hazard in the study area (Figure 3-1 to Figure 3-3). Although historical accretion trends in MU3 and MU3 reduced the potential area at risk, the mapping shows large areas of land and some assets potentially at risk over the next 100 years.

The inundation assessment, however, confirmed there are no expected impacts of inundation, and as such, inundation did not need to be considered further throughout the CHRMAP. Figure 3-4 shows that Windy Harbour is less affected by inundation than erosion. This finding aligns with the information received during the site visit and community engagement sessions.

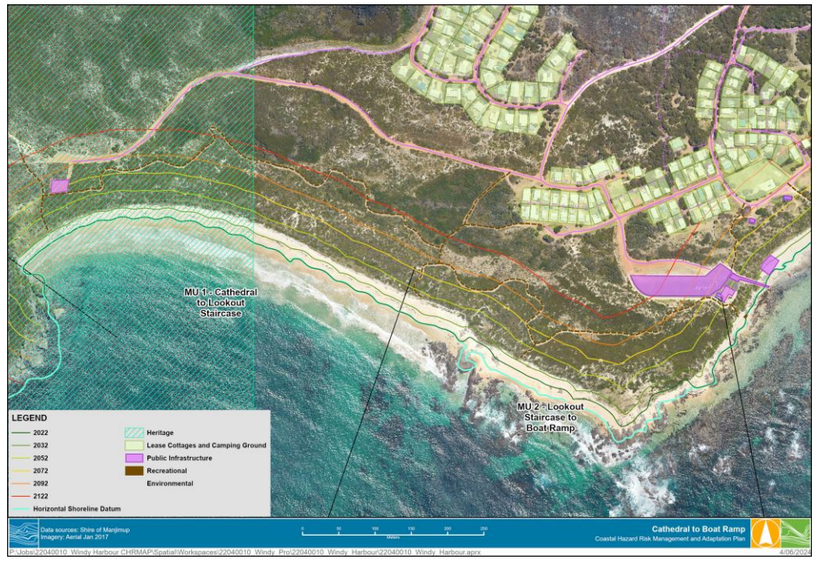

Figure 3-1 Projected Erosion Hazard Lines for MU1 and MU2

Figure 3-2 Projected Erosion Hazard Lines for MU3

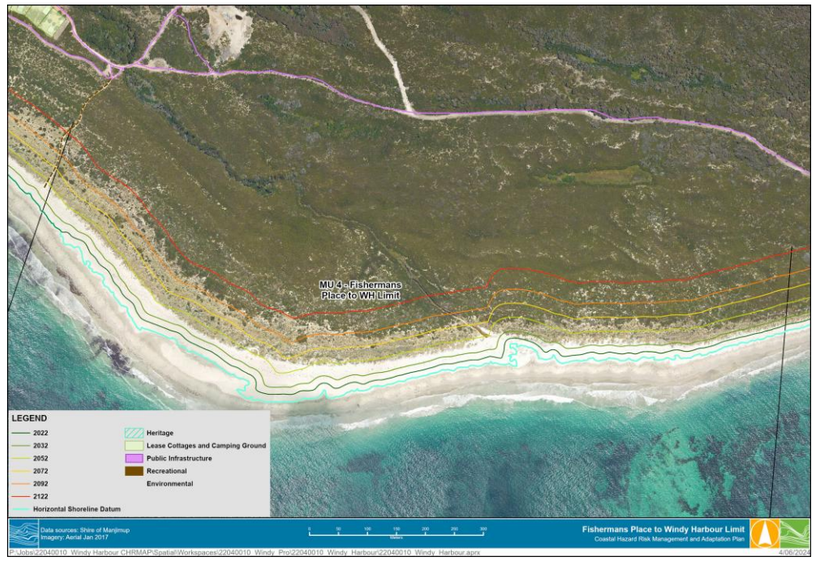

Figure 3-3 Projected Erosion Hazard Lines for MU4

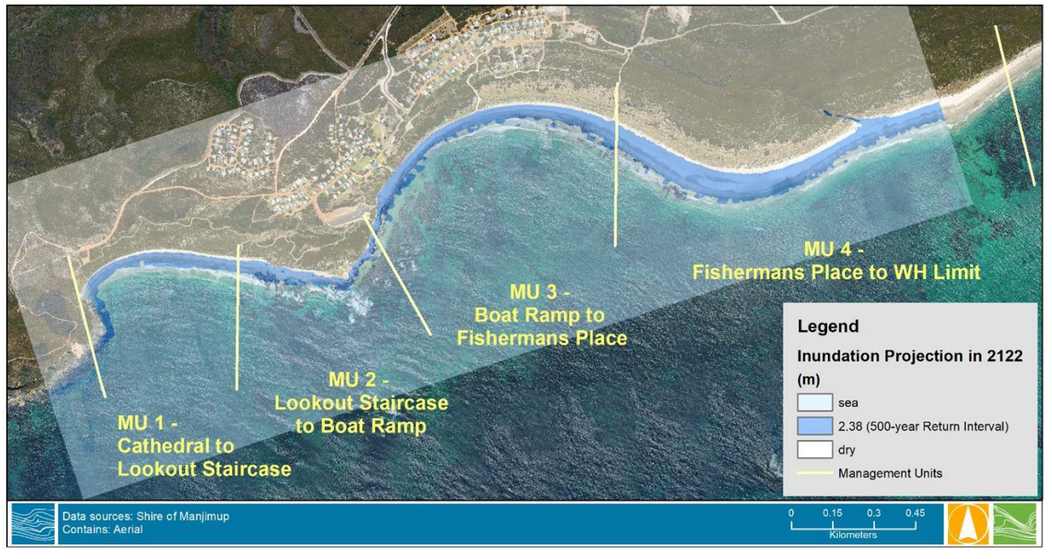

Figure 3-4 Inundation Hazard at Windy Harbour

4 VULNERABILITY ANALYSIS

Assets at risk of coastal erosion were identified and assigned a vulnerability rating. The vulnerability results are presented in full in the Vulnerability Analysis Chapter Report (Appendix C). A summary of the results is presented below.

4.1 Asset Classifications

Assets are grouped according to classification for ease of interpretation. Assets are grouped according to classification for ease of interpretation. For the purposes of this report, Water Technology grouped assets into five categories - public infrastructure, recreational, lease cottages and camping grounds, environmental, and heritage.

Public Infrastructure

- This includes a car park, boat ramp, roads, VMR Building, Shire buildings, and water supply.

Recreational

- This includes the beach, coastal tracks, lookouts, beach access paths and staircases, and sheltered shallow water.

Lease Cottages and Camping Ground

- This includes residential and professional fishing leases, camping sites and related infrastructure.

Environmental

- This includes the beach and the foredunes.

Heritage

- This includes heritage sites, such as registered Aboriginal Heritage areas.

4.2 Identified Assets

Table 4-1 presents the identified assets by management unit and category. Categorized assets vulnerable to erosion for each MU are mapped and shown in Figure 3-1 to Figure 3-4.

Table 4-1 Number of Assets at Risk, grouped by Management Unit and Planning Horizon

Asset Classification Group	Assets	2022 (Present)	2032 (+10 years)	2052 (+30 years)	2072 (+50 years)	2092 (+70 years)	2122 (+100 years)	Summary
Management Unit 1 (MU 1)								
Public infrastructure	Community building, Shire building (Information Centre, Toilet block, Measuring instruments, Store area), Telstra Utility (No.)	Nil						No building properties are present in MU 1. Beach and foredune, are at risk to erosion at present. Heritage site present at east end of MU 1 is at risk to erosion at present. Beach access becomes at risk to erosion by 2052 (+30 years). Small car park exists in MU 1, classed as at risk to erosion by 2072 (i.e., 50-year planning horizon). Old Lighthouse Road becomes at risk to erosion by 2092, at 70-year planning horizon.
	Water Distribution Network (m)	Nil						
	Car park, Roads (m^2)	0	0	0	122	664	1,755	
Recreational	Beach Seating (No.)	Nil						
	Beach access (m^2)	0	0	40	271	599	1,291	
Lease Cottages and Camping Ground	Residential and professional fisherman leases (No.)	Nil						
	Camping sites and their infrastructure (m^2)	Nil						
Environmental	Beach and foredunes (m^2)	7,354	21,987	36,839	51,888	75,269	7,354	
Heritage	Aboriginal heritage site (m^2)	0	4,438	13,392	22,759	32,625	48,398	
Management Unit 2 (MU 2)								
Public infrastructure	Community building, Shire building (Information Centre, Toilet block, Measuring instruments, Store area), Telstra Utility (No.)	Nil						No building properties present in MU 2. Beach and foredune are at risk to erosion at present. *Coastal Survivors Walk* beach access becomes at risk to erosion by 2052 (+30 years). Car park exists near Boat ramp, classed as at risk to erosion by 2072 (i.e., 50-year planning horizon). Boat Ramp Road becomes at risk to erosion by 2092, at 70-year planning horizon.
	Water Distribution Network (m)	Nil						
	Car park, Roads (m^2)	0	0	0	238	1,230	2,646	
Recreational	Beach Seating (No)	Nil						
	Beach access (m^2)	0	0	92	369	1055	1,682	
Lease Cottages and Camping Ground	Residential and professional fisherman leases (No.)	0	0	0	0	0	0	
	Camping sites and infrastructure (m^2)	Nil						
Environmental	Beach and foredunes (m^2)	6,048	13,330	26,428	38,364	48,700	64,330	
Heritage	Aboriginal heritage site (m^2)	Nil						
Management Unit 3 (MU 3)								
Public infrastructure	Buildings: Community building, Shire building (Information centre, Toilet block, Measuring instruments, Store area), Telstra Utility (Nos)			1	2	8	8	Beach, foredune, beach access, and Boat ramp are at risk to erosion at present. Community building and Public Toilet present in MU 3, becomes at risk to erosion by 2052 (+30 years).
	Water Distribution Network (m)	0	0	0	0	120	201	

Asset Classification Group	Assets	2022 (Present)	2032 (+10 years)	2052 (+30 years)	2072 (+50 years)	2092 (+70 years)	2122 (+100 years)	Summary
	Boat Beach Landing, Boat Ramp, Car park, Roads (m^2)	58	407	698	1,080	1,540	3,115	Car park exists near Boat ramp, and Telstra utility classed as at risk to erosion by 2072 (i.e., 50-year planning horizon). Shire buildings, water distribution network, Windy Harbour Road becomes at risk to erosion by 2092. Campground, Camp playground and Windy Harbour leases become at risk to erosion by 2122, 100-year planning horizon.
Recreational	Beach Seating (No.)	1	1	1	1	1	1	
	Beach access (m^2)			383	720	1,021	2,752	
	Community Playground (m^2)						2,041	
Lease Cottages and Camping Ground	Lease and campground building (No.)	0	0	0	0	0	6	
	Camping sites and minor infrastructure (m^2)	0	0	0	0	0	1,406	
Environmental	Beach and foredunes (m^2)	12,871	36,983	60,692	83,800	112755	12,871	
Heritage	Aboriginal heritage site (m^2)	Nil						
Management Unit 4 (MU 4)								
Public infrastructure	Community building, Shire building (Information Centre, Toilet block, Measuring instruments, Store area), Telstra Utility (No.)	Nil						No building properties present in MU 4. Beach and foredune are at risk to erosion at present. Beach access in MU 4 is along beach, which starts in MU 3.
	Water Distribution Network (m)	Nil						
	Boat Beach Landing, Boat Ramp, Car park, Roads (m^2)	Nil						
Recreational	Beach Seating (No.)	Nil						
	Beach access (m^2)	Nil						
Lease Cottages and Camping Ground	Residential and professional fisherman leases (No)	Nil						
	Camping sites and infrastructure (m^2)	Nil						
Environmental	Beach and foredunes (m^2)	17,992	36,550	71,641	105,934	139,858	190,152	
Heritage	Aboriginal heritage site (m^2)	Nil						

4.3 Analysis Method

A vulnerability assessment defines the degree of impact coastal hazards are likely to have on coastal assets over the planning timeframe. The vulnerability of coastal assets to coastal hazards is related to their exposure to the hazard, their sensitivity to that exposure, and the ability of the asset to be modified or adapted to manage this exposure. This is displayed diagrammatically in Figure 4-1; the input components are displayed in blue.

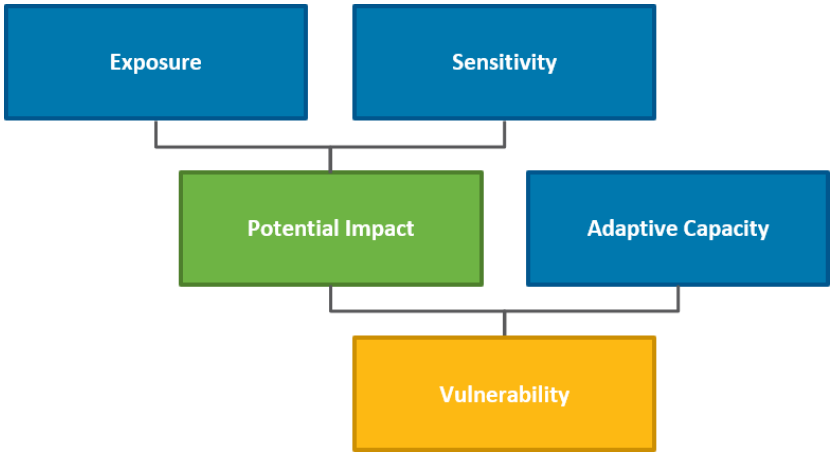

Figure 4-1 Vulnerability assessment components (reproduced from Allen Consulting, 2005)

The **exposure/likelihood** of identified assets represents the likelihood of coastal hazards impacting an asset. That is, the chance of erosion and/or storm surge inundation impacting existing and future assets and their values.

The **sensitivity/consequence** is an asset's responsiveness to a coastal hazard. This could be a gradual or stepped change response to discrete events (WAPC, 2019). The sensitivity can be applied to the asset itself or to its function and the criticality of its service.

Risk level, or **potential impact**, is calculated as the product of exposure and sensitivity (Figure 4-2). It provides a classification of the potential impact of coastal hazards on identified assets, which was determined for each project timeframe.

The **adaptive capacity** is the asset's ability to adjust/adapt to the identified hazard. It was determined based on the potential for the system to be modified to cope with the impacts of coastal hazards. Assets with high adaptive capacity can easily be adapted. For instance, beach and dune systems often have higher adaptive capacity than coastal infrastructure and residential land.

Vulnerability is calculated as the product of potential impact (risk level) and the adaptive capacity (Figure 4-2). As per WAPC (2019), four levels of vulnerability are considered in this study, and they should be assessed for each of the planning timeframes considered by this CHRMAP. **Vulnerability** ratings are Extreme, High, Medium and Low.

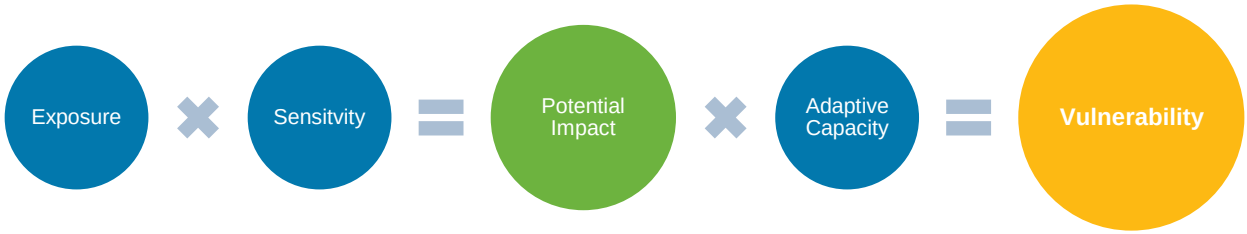

Figure 4-2 Vulnerability relationship

4.4 Results

The assessment method was applied to all identified asset categories for each planning horizon for each MU to identify vulnerability ratings, as presented in Table 4-2. The following key observations can be made from the results:

- No assets were identified as vulnerable to coastal inundation – this hazard was not analysed in detail and not considered further in the project.
- Erosion is a significant concern as it currently has high vulnerability ratings.
- Beach and foredune areas are currently vulnerable to erosion, which is highly valued by the community.
- All categories are at high or extreme vulnerability to erosion from the present day.
- The Heritage site at the west end of MU 1 is vulnerable to erosion.
- The boat ramp is vulnerable to erosion at present.
- Community building, Public Toilets and the *Coastal Survivors Walk* beach access becomes vulnerable to erosion by 2052 (+30 years). The car park near the boat ramp and the Telstra utility are classed as vulnerable to erosion by 2072 (i.e., 50-year planning horizon). Shire building, measuring instruments, store area, Water distribution network, Windy Harbour Road, Old Lighthouse Road, and Boat Ramp Road become vulnerable to erosion by 2092. Campground, Camp playground, Windy Harbour leases become vulnerable to erosion by 2122, 100-year planning horizon.

High and Extreme vulnerability has been identified from the present day onwards. Most categories are considered unacceptably vulnerable and require adaptation planning to consider the best way to treat the risk. The results may appear alarming, but it is sometimes considered conservative because the CHRMAP process relates to land-use planning. The method and results are also used to consider vulnerability to coastal inundation, which is insignificant in this study area but commonly results in lower vulnerability ratings because assets are wet (often temporarily) rather than lost to erosion. The Community and Stakeholder Engagement undertaken for the project highlighted how valuable the study area's environmental and heritage values and assets are to the local community and visitors. Similarly, the boat ramp, marine rescue facilities, lease cottages, and camping grounds were identified as of primary importance to the community, and as such are considered unacceptably vulnerable to erosion.

Table 4-2 Erosion Vulnerability Ratings, Grouped by Management Unit and Planning Horizon.

Assets Classification Group	2022	2032	2052	2072	2092	2122
Management Unit 1 (MU 1)						
Public infrastructure	High	Extreme	Extreme	Extreme	Extreme	Extreme
Recreational	Extreme	Extreme	Extreme	Extreme	Extreme	Extreme
Lease Cottages and Camping Ground	Not applicable in MU1					
Environmental	Extreme	Extreme	Extreme	Extreme	Extreme	Extreme
Heritage	Extreme	Extreme	Extreme	Extreme	Extreme	Extreme
Management Unit 2 (MU 2)						
Public infrastructure	High	Extreme	Extreme	Extreme	Extreme	Extreme
Recreational	Extreme	Extreme	Extreme	Extreme	Extreme	Extreme
Lease Cottages and Camping Ground	High	High	High	Extreme	Extreme	Extreme
Environmental	Extreme	Extreme	Extreme	Extreme	Extreme	Extreme
Heritage	Not applicable in MU2					
Management Unit 3 (MU 3)						
Public infrastructure	Extreme	Extreme	Extreme	Extreme	Extreme	Extreme
Recreational	Extreme	Extreme	Extreme	Extreme	Extreme	Extreme
Lease Cottages and Camping Ground	High	High	High	Extreme	Extreme	Extreme
Environmental	Extreme	Extreme	Extreme	Extreme	Extreme	Extreme
Heritage	Not applicable in MU3					
Management Unit 4 (MU 4)						
Public infrastructure	Not applicable in MU4					
Recreational	Not applicable in MU4					
Lease Cottages and Camping Ground	Not applicable in MU4					
Environmental	Extreme	Extreme	Extreme	Extreme	Extreme	Extreme
Heritage	Not applicable in MU4					

5 RISK EVALUATION AND TREATMENT

A Risk Evaluation and Risk Treatment Options Chapter Report (Appendix D) was prepared, assessing any available controls against the vulnerability ratings assigned during the vulnerability analysis. Any vulnerability rating of medium or above is considered unacceptable; therefore, all MUs must be considered for risk treatment options.

5.1 Risk Management and Adaptation Hierarchy

SPP2.6 provides a risk management and adaptation hierarchy to guide decision-making in coastal areas, which can be used by planning authorities and development proponents when considering adaptation options to minimise coastal hazard risks at the local level. The hierarchy, presented in Figure 5-1, indicates a clear preference against the adoption of 'protect' as a long-term adaptation pathway. This preference is re-emphasised in SPP2.6, the policy guidelines, the CHRMAP Guidelines and the WA Coastal Zone Strategy.

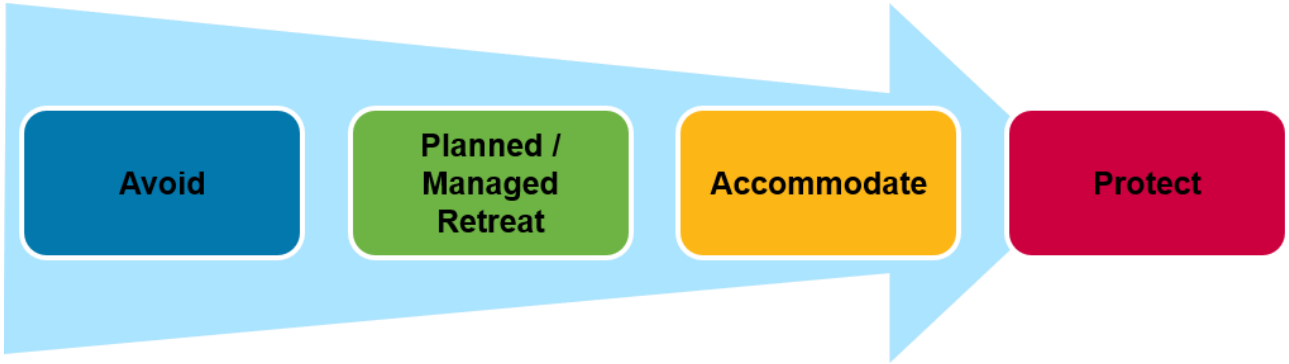

Figure 5-1 Coastal hazard risk management and adaptation planning hierarchy (adapted from WAPC, 2019)

Maintaining public access to the coast in developed areas is one of the main objectives of SPP2.6. The State legislative framework means that public access and trespass issues will likely arise where the shoreline recedes beyond private property boundaries. This situation implies that public authorities have two main adaptation options available to them for preserving public coastal access:

- **Planned or Managed Retreat,** i.e., maintaining a foreshore reserve through public acquisition of private property; or,
- **Protect,** i.e., preventing the shoreline from receding beyond private property boundaries by stabilising the current shoreline position using various protection measures.

Where public authorities cannot commit to either of these options over the long term, they will likely need to accommodate the coastal hazard risk by modifying local planning frameworks to appropriately design and locate new development. Public authorities in this situation may also consider the appropriateness of interim Protection measures to preserve public interests by delaying shoreline recession.

The CHRMAP process aims to minimise coastal hazards and maximise the beneficial use of the coast. Therefore, adaptation options should follow the following principles:

- Adaptation options should minimise coastal process interference and legacy issues.
- Coastal development must be sustainable in the long term and must balance the community, economic, environmental and cultural needs.
- Local Governments are responsible for managing risks to public assets and any assets they manage. They should also:

  - Develop local policies and regulations consistent with state legislation and policy.
  - Facilitate building resilience and adaptive capacity within the local community.
  - Work in partnership with the community to identify and manage risks/impacts.
- Management strategies that preserve the natural coastline and move development away from the active coastal zone in an orderly manner are considered ideal. Of particular relevance to the CHRMAP process is the user-pays principle, whereby those who benefit most from protection must provide the greatest financial contribution.
- Adaptation options should maintain future flexibility to build resilient coastal communities.
- A key adaptation option will be planning mechanisms, including Planned / Managed Retreat.

5.2 Multi-Criteria Analysis

Successful risk management and adaptation planning requires identifying and assessing suitable risk treatment options to select the best strategy. The selected risk treatment option should mitigate risk to an acceptable level whilst maximising the values important to the stakeholders. A Multi-Criteria Analysis (MCA) was undertaken to assess suitable adaptation options for the study area. The MCA assessment criteria were as follows:

- Effectiveness
  - The ability for the option to mitigate the coastal hazard risk.
- Environmental Impact
  - Impact on existing native vegetation/dunes / coastal processes.
  - Includes consideration of:
    - Any construction/clearing impacts.
    - Impact of maintenance on the environment.
- Social Impact
  - This considers stakeholder and community impacts from previous CHRMAP chapters.
  - Potential impacts on heritage sites and values are considered in this criterion.
- Aesthetic Impact
  - The visual appeal of the option.
  - Consideration of option aesthetics tying into the broader study area/ Management Unit vision.
- Cost
  - Upfront capital costs.
  - Ongoing maintenance costs.
  - Economic effects – such as loss of businesses, income, and value.
- Future Adaptability
  - Whether the option is easily adaptable in future, such as for updated sea level rise actuals or predictions.
  - If the option limits the feasibility of selecting other options in future.

The MCA results are rated from negative to positive. The adaptation options with a rating of zero and above were recommended for further investigation in a Cost Benefit Analysis (CBA;Table 5-1). Options receiving a positive score are recommended for further consideration.

Table 5-1 Multi-Criteria Analysis summary by MU.

Green indicates an option is recommended for further investigation, and red indicates an option is not recommended for further investigation. Options codes are from WAPC (2019).

Option	MU1	MU2	MU3	MU4
Locating assets in areas that will not be vulnerable to coastal hazards (AV)	12	12	11	12
Leaving assets unprotected (PMR1)	2	2	2	7
Demolition / removal / relocation of asset from inside hazard area (PMR2)	7	7	7	N/A
Prevention of further development / prohibit expansion of existing use rights (PMR3)	6	6	6	6
Voluntary acquisition (PMR4)	N/A	N/A	N/A	N/A
Beach nourishment or replenishment (PR1)	3	3	3	3
Groynes (PR2)	-5	-6	-6	-6
Seawalls (PR3)	-7	-6	-7	-8
Artificial reef (PR4)	-4	-3	-3	-6
Offshore breakwater (PR5)	-9	-6	-8	-9
Monitoring (NR1)	7	7	7	7
Protection Structure Audit (NR2)	N/A	N/A	N/A	N/A
Notification on title (NR3)	N/A	N/A	N/A	N/A
Do nothing (DN1)	-10	-10	-10	-10

6 ASSESSMENT OF RISK TREATMENT OPTIONS

An Assessment of Risk Treatment Options Chapter Report (Appendix E) was prepared to analyse options using Cost-Benefit Analysis (CBA). A summary is provided below.

6.1 Cost-Benefit Analysis

The purpose of the CBA was further to examine the selection of adaptation options through economic analysis. In the previous project stage, potential adaptation options were assessed against a range of criteria, including cost. Options that may require significant financial investment and scored positively in the MCA were included in the CBA. A rigorous assessment of costs and benefits for each option assists with preferential selection to ensure that a selected adaptation option is economically defendable. The CBA has addressed the value of the loss of assets and managed retreat and physical protection options. Losses or costs are assessed at each project timeframe. Indirect costs that another user might consider to be a loss are not considered. For example, costs associated with Special Control Area (SCA) title notifications, emergency planning or development restrictions are not considered.

The cost-benefit of each option is presented in net present value (NPV) terms. NPV is a standard economic analysis that compares options with time-variable costs and benefits. It allows for adjusting all future economic considerations to present-day dollars for a more direct comparison. This relates to the time-value of money, as planned expenses in the future are, in a sense, cheaper than equivalent costs today because the money required for a future expense could be spent elsewhere today to provide value over time (i.e., it can be invested now to generate a return). An expense that occurred today could not be invested elsewhere. In this case, all cashflows are costs, so options with a lower net present value are considered better investments from a financial standpoint.

The real discount rate chosen for this project was 4%, with sensitivity analyses at 7% and 2%. This decision was based on similar assessments (DPMC, 2016; Transport for NSW, 2022; Baird, 2020; APH, 2018; Abelson and Dalton, 2018), the very long timeframe of analysis, and concerns that valuing future spending too low is at odds with resilient coastal planning principles.

The discount rate converts all future costs back to today's dollar value for comparison (in the NPV). For example, a project with a cost of $1 million per year for 10 years would discount to an NPV of roughly $7.5 million, whereas a project that only has a single outlay of $10 million in 10 years' time would have an NPV of roughly $5.4 million, both discounted at 7%. A project that costs $10 million today would have an NPV of $10 million. This example shows the importance of when a cost is realised.

The CBA has been performed over the project timeframe – notionally 2022 to 2122, to match the project planning timeframe and meet the requirements of the CHRMAP. It should be noted that the uncertainty around the CBA estimates and assumptions made grows with time. Estimates beyond 2040 should be viewed as indicative trends only. Long-term adaptation pathways should always be monitored and updated over time.

The adaptation options recommended for further analysis following the MCA and considered suitable for CBA were:

- Planned / Managed Retreat – Demolition/removal/relocation of asset from inside hazard area (PMR2): removal of vulnerable assets over various timeframes per MU as identified by the hazard mapping.
- Protection: Beach nourishment or replenishment (PR1): Placement of sand within the beach profile and/or dunes to activate beach coastal processes and provide a sediment supply along the whole length of the relevant MU.

The remaining adaptation options from WAPC (2019), which received a positive MCA score, were not considered suitable for CBA and have been costed using traditional budgeting techniques. They are presented in Section 7.

6.2 Results

The CBA has been used as an additional tool to assist decision-making when assessing adaptation options for which to proceed. The reality that only some of the WAPC adaptation options are suitable for CBA, and the uncertainty in the effectiveness of those that are not suitable, means that the CBA results need to be used cautiously whilst considering the rest of the information identified during the CHRMAP project.

A review of the CBA results shows that the ranking of options for each MU by NPV does not depend on which discount rate is used for any of the MUs. This provides a reasonable argument for selecting a single option with which to proceed, compared to if the ranking changed depending on the discount rate, but is also dependent on the assumptions used.

From the WAPC hierarchy, “Avoid” is only practical for parts of MU1 and MU2. The “Accommodate” option principally applies to coastal inundation. The remaining results considered in the CBA process are essentially to consider the advantages and disadvantages of “Retreat” (PMR2) or “Protect” (PR1) Options for the erosion hazard.

Options recommended to proceed are presented in Table 6-1. For MU1, the PR1 Beach Nourishment option outperforms PMR2: Demolition/removal/relocation of asset from inside hazard area and the economic base-case for all discount rates but only by a small margin. For all other MUs, the PMR2: Demolition/removal/relocation of asset from inside hazard area option and the economic base-case outperforms the PR1 Beach Nourishment option for all discount rates.

Table 6-1 Recommended CBA Options for Erosion for each MU

Management Unit	Recommended Option	Notes
MU1	PR1 Beach Nourishment	■ PR1 Beach Nourishment is recommended based on the results of the CBA. ■ As Implementation is not anticipated to be required until 2052 preparation for this option at this MU should focus on monitoring the evolution of the coast, investigating sand source feasibility, and further engagement regarding the values of the area (environmental and heritage in particular) to prioritise sections of coast for protection.
MU2	PMR2: Demolition/removal/ relocation of assets from inside hazard area	■ PMR2: Demolition/removal/relocation of assets from inside hazard area is recommended based on the results of the CBA. ■ Preparation for this option at this MU should focus on monitoring the evolution of the coast, asset management planning for built infrastructure, including public, lease cottages and campgrounds, beach access and foreshore paths.

Management Unit	Recommended Option	Notes
MU3	PMR2: Demolition / removal / relocation of assets from inside hazard area	■ PMR2: Demolition / removal / relocation of assets from inside the hazard area is recommended based on the results of the CBA. ■ Preparation for this option at this MU should focus on monitoring the evolution of the coast and asset management planning for existing built infrastructure. ■ The boat ramp, beach tractor parking, beach boat launching areas, and pedestrian and vehicle beach access have been identified as important local assets. Short-term management should focus on these items. ■ The built assets projected to be impacted by erosion first are public assets. Strategic planning should be undertaken to identify appropriate locations for their replacement and/or suitable temporary accommodation strategies until the asset is relocated. ■ Alternatively, beach nourishment could be used to protect smaller priority sections of this MU as required, and local-scale temporary works could also be considered on a case-by-case basis depending on how the coast evolves and assets become threatened/impacted.
MU4	AV: Locating assets in areas that will not be vulnerable to coastal hazards And NR1: Monitoring	■ PR1 Beach Nourishment was identified as more expensive than the economic base case. ■ As this area is undeveloped land, there are no built assets and no environmental or heritage assets have been identified as unique to this MU. ■ The primary recommendation for the whole MU is to Avoid locating assets in vulnerable areas. Future development could be possible with appropriate setbacks. ■ As the Shire is likely to have a limited budget for coastal management in general, it is recommended that this MU is allowed to retreat naturally. ■ Monitoring the evolution of the coast should be the focus in the short term. This MU could ultimately be used as a harvest area or sand nourishment back passing area to undertake beach nourishment in the other MUs.

For the PR1 Beach Nourishment option, the year of implementation was selected to preserve some foreshore reserves and further inland development. This acknowledges the underlying qualitative value of the vegetated foreshore reserve in line with the objectives of SPP2.6. If these areas were considered of very high importance, the implementation could have been considered earlier. Alternatively, if these areas were considered less important to this study, implementation could be delayed until more landward assets become unacceptably vulnerable. The existing estimate on the timeframe for implementation shows that there is time to consider these competing priorities in more detail following further investigations to develop the options. Filling any existing data and/or knowledge gaps (e.g. suitable sand source, costing assumptions) is considered critical in confirming the recommended options before processing with implementation. Likewise, enforcing planning regulations (e.g. limiting further development seaward of the hazard lines and limiting intensification) and undertaking ongoing monitoring of coastal processes is considered essential. Future CHRMAP reviews will be required to confirm or change the recommended option before its recommended implementation timeframe.

The CBA analysis is contingent on assumptions about NPV discount rates and unit cost rates. Notwithstanding these assumptions, the process provides a tool to assist decision-makers in drawing comparisons between several coastal adaptation options. The extensive study area allows the consistent application of the CBA across a large section of the coast.

PR1 Beach Nourishment and PMR2: Demolition/removal/relocation of assets from inside hazard area are both recommended to proceed for further investigation for different MUs. The recommendations consider the CBA results holistically and are cognisant of the findings of previous stages of the CHRMAP. Other non-CBA options also form part of the recommended management approach and are presented in Section 7, providing further detail for the investigations and implementation of options. A more detailed investigation is required to determine the scope and extent of such works. The unit cost assumptions need to be confirmed through further design and procurement studies. Similarly, the procurement of sand suitable for nourishment works in the study area will need to be the subject of further investigation.

7 IMPLEMENTATION

An Implementation and Monitoring Chapter Report (Appendix G) was prepared to present recommended actions to progress coastal hazard adaptation planning for the study area. A summary is provided below.

7.1 Recommended land use planning instruments

There is a direct relationship between coastal hazard exposure and development. How buildings and assets are designed and located determines their exposure, ultimately impacting risk to people and property. Therefore, development planning controls are an important tool to reduce risk exposure.

> *Land use planning has an important role to play in increasing the resilience of coastal areas to sea level rise, storm surge inundation, and erosion, as they govern how coastal areas are developed and managed.*

This section outlines the key planning-based mechanisms the Shire can implement in response to the coastal hazards identified in the CHRMAP. As the coastal inundation hazard has been identified as insignificant for this study area, the planning mechanisms have only been prepared to respond to the impacts of coastal erosion.

7.1.1 Special Control Areas / Special Use Zone No.5

It is an advantage that Windy Harbour is already the subject of a special zone (Special Use Zone No. 5; SU5) in LPS 4. The provisions of SU5 remain largely relevant, but consideration of coastal hazards is not explicit. Rather, SU5 relies on reference to generic considerations that apply to all development in the Shire of Manjimup and includes Clause 10.2 (xiv) whether the land is or is likely to be at risk from various environmental hazards including flooding or tidal inundations.

The options for improvement of SU5 to explicitly address coastal erosion hazards are listed and further outlined in the following subchapters:

- Amend the provisions of SU5 to explicitly require adherence to relevant coastal planning adaptation measures.
- Introduce a Special Control Area (SCA) over land identified as being at risk of coastal erosion (as described in 2.1 of the Risk Evaluation and Risk Treatment Options chapter of the CHRMAP).
- Both of the above.
- Do nothing.

7.1.1.1 Amend Special Use Zone No.5

Amendment to SU5 would be desirable and could be carried out in the same amendment as introduction of a Special Control Area. The recommended amendment would (as a minimum):

(i) Add a third environmental management objective, as follows:

- *Ongoing management of the reserve will be in accordance with the Windy Harbour CHRMAP and the provisions of Special Control Area No. 11 – Windy Harbour.*

(ii) Add the following to the list of matters the local government must have regard to when determining applications in Windy Harbour:

- *The recommendations of the Windy Harbour CHRMAP and the requirements of Special Control Area No. 11 – Windy Harbour.*

7.1.1.2 Introduce a Coastal Hazards Special Control Area

Part 6 of LPS 4 and Development Investigation Areas (Structure Plan Areas) at Section 6.1 lists and includes provisions for the operation of Special Control Areas (SCA), with requirements specific to particular SCAs contained in Schedule 11.

There is currently no SCA for areas at risk from coastal erosion or inundation. As Windy Harbour is not the only coastal part of the Shire of Manjimup, conceivably there could be other areas in the future that could also benefit from being identified within an SCA.

LPS 4 would be amended to:

(i) Introduce provisions applicable to all land identified within a Coastal Hazards SCA. A new Division D – Coastal Hazard Management Areas would be required in cl. 6.1.1, with Windy Harbour SCA being listed as item (xi) and referencing Schedule 11 – Division D.

(ii) Add a new Division D to Schedule 11 for Coastal Hazard Management Areas, with specific provisions for the Windy Harbour Coastal Hazards Area (SCA 11/1).

(iii) Designate land within the 2122 coastal erosion hazard line as identified by the CHRMAP as SCA No. 11 - Windy Harbour on the Scheme Map. Alternatively, the whole of SU5 could be designated as an SCA.

(iv) Define the SCA boundary on the Scheme Map; at a minimum recommended to correspond with MU2 and MU3, where demolition/removal/relocations of assets from inside the hazard area is the recommended management response.

Wording of a scheme amendment would be based on that in Appendix 4 (Appendix 2 thereof) of WAPC (2019).

7.1.2 Windy Harbour Management Plan

By virtue of SU5 (cl. 1), the current Windy Harbour Management Plan (WHMP) 2007 – 2017 has the status of a Structure Plan. A Structure Plan is a guiding document that is given due regard in decision-making for future development, unlike the local planning scheme, which has statutory effect.

The current plan was a review of the 1999 plan and was endorsed by Council in 2007. All Structure Plans approved prior to the gazettal of the Regulations are deemed to have been approved on 19 October 2015 and have effect for ten years from that date. Therefore, the current ‘Structure Plan’ will expire on 19 October 2025 unless the approval date is extended.

Structure plans are required to be endorsed by the WAPC and to address a range of land use considerations as set out in the Regulations. The current plan would not meet contemporary requirements for a Structure Plan.

As the term of the management plan has expired, an update is required; it should be replaced with either a compliant Structure Plan, a local planning policy or other formal planning tool. This matter should be discussed with the WAPC to determine the preferred approach.

Key issues that an updated WHMP would need to address, in addition to referencing the findings and recommendations of this CHRMAP, include:

- Whether and where new sites can be developed to accommodate infrastructure and sites lost to coastal erosion, taking into account the other constraints on the site, such as proximity to the Priority 1 Public Drinking Water Source Area.
- How the movement network can be progressively reconfigured in response to erosion events, to provide ongoing access for sites and to the beach. The movement network includes vehicle and pedestrian routes.
- Options for reconfiguration/relocation of infrastructure in response to erosion events.

7.1.3 Leases

It is recommended that the Shire obtain legal advice on the need for, the mechanisms to achieve, and the timing of any amendments necessary to the current lease agreements and the length of renewal periods, to achieve any required relocation of lease cottages in a timely manner.

7.2 Funding options

Revenue-raising mechanisms are available to obtain funds to assist implementation, and funding mechanisms for implementation include:

- Operating budget, general rates and coastal management fund.
- Special area rates / differential rating.
- Levies.
- Lease land management.
- State grants.
- Federal grants; and
- Beneficiary pays.

7.3 Monitoring and Review

Monitoring is essential to managing coastal hazards, tracking when coastal hazards reach trigger points, understanding the coastline evolution, capturing changes to vulnerabilities and measuring the success of coastal management actions. Coastal monitoring will be required throughout the planning timeframe to inform ongoing implementation and increase the knowledge base for subsequent CHRMAP revisions and targeted investigations. A more detailed site-specific monitoring program could be developed for Windy Harbour if funding is available, but given the timeframes of projected hazards and vulnerability, the actions described below are likely to be sufficient for several years.

The following coastal monitoring activities are recommended to record the evolution of coastal trigger points:

1. Routine beach and dune surveys, in the form of beach profile surveys, are recommended yearly, following the winter season, at least every 400m along the coast, ensuring that at least two profiles are collected per MU. Beach profiles may be spaced more closely, where options include monitoring trigger points and/or supporting specific project requirements. The beach survey may also be continuous along the coast using LiDAR (or other appropriate techniques) to enhance the understanding of coastal processes and beach responses. Additionally, surveys should be undertaken immediately following severe storms producing significant beach erosion. These are useful for recording historical events, confirming the presence of bedrock, and calibrating models. Beach profile datasets should include the location of the Horizontal Shoreline Datum (HSD). The beach profiles must extend from the edge of the coastal cadastral boundary down to the Lowest Astronomical Tide (LAT). The survey datasets should be centralised into a database, which includes previous historical beach profiles and quality control information such as survey data, datum, survey mark, beach material encountered (rock vs sand) and methods used.

2. Corresponding monitoring photos should be taken at the same time as beach surveys.

Additionally, the ongoing state (DoT) and federal (BoM) monitoring should continue, including:

- Shoreline vegetation movement analysis from aerial photos undertaken by DoT,
- Regional water level monitoring undertaken by DoT,
- Regional wave monitoring by DoT: additional localised wave data monitoring is recommended to supplement the existing regional wave buoy data if the construction of coastal management structures or any modifications to the boat ramp is proposed,
- Bathymetric survey of the entire study area to a minimum 10m depth by DoT to include the nearshore reefs and
- Regional wind recording by BOM.

7.3.1 Trigger Points

The CHRMAP considers four trigger point types and follows a sequential / priority order. For example, a "proximity trigger" is recommended over a "damage trigger":

- **Proximity trigger**: Where the most landward part of the Horizontal Shoreline Datum (HSD) is within the Storm Erosion Allowance of the most seaward point of an asset or property of interest. If individual assets have a specific distance-based trigger relating to the HSD, then the beach and dune survey activities described above should be used to collect topographic data that can be used to map the updated HSD position.
- **Access trigger**: Where a public road is considered no longer available or able to provide legal access to the property.
- **Utilities trigger**: When water, sewage, communications or electricity to a property is no longer available as they have been removed/decommissioned by the relevant authority due to coastal hazards.

Damage trigger: Any property within the hazard zone and within a dedicated Special Control Area which is damaged by a coastal hazard shall require LGA approval before being repaired. The review process should involve a re-fit of minor or moderately damaged assets to accommodate coastal hazards in the future or removal and redevelopment outside the hazard zone for damaged assets.

7.3.2 CHRMAP Review

It is recommended this CHRMAP is updated every 5 to 10 years to maintain currency and should be a "living document". An earlier review should be considered when the following event occurs:

- Substantial storm event(s) generating coastal hazards approaching or exceeding the CHRMAP projections.
- Significant changes to land-use planning – such as complex amendments to, or full review of, the Local Planning Scheme.
- New information that substantially affects the summary of local community values and assets (natural or built) becomes available. This may occur when consulting the community regarding related documents, such as the Local Planning Scheme or Foreshore Management Plan or the occurrence of a significant storm event.
- Hazard modelling for the study area should be updated given any of the following:
  - recent data collection,
  - planning changes,

- updates in climate change science, specifically local sea level rise projections,
- coastal engineering methodology,
- changes to the CHRMAP success criteria by coastal land managers or
- triggers are reached.

Any coastal management operations within the study area should consider the status of short- and long-term adaptation strategy progress, including assessing the performance and reviewing any identified strategies.

Monitoring of CHRMAP outcomes, actions and future updates should always include consultation with stakeholders and the community to make sure any changes are communicated, and that the stakeholders' positions are reflected in the coastal management outcomes.

7.3.3 Boat Ramp

Throughout the engagement activities undertaken during this CHRMAP project, community members have clearly and repeatedly raised the importance of the Windy Harbour Boat Ramp to the local and broader community.

SPP2.6 (WAPC, 2013) recognises that boat ramps must occur within areas identified to be impacted by physical coastal processes. SPP2.6 requires them to be considered within a CHRMAP framework, identified in a strategic plan and co-located with other public recreation and coastal node facilities. Any proposed development will be assessed case-by-case against the SPP2.6 Policy Measures and in consultation with other relevant agencies and the community.

The boat ramp is exposed to ocean forces and currently experiences sand and seagrass/seaweed wrack deposition, which can affect operability. The Shire removes the sand and wrack as required, and this should continue. Records of the volume and type of material should be collected to inform future management options. Regular condition inspections of the ramp should be conducted to inform future management and the remaining design life. Any maintenance or changes to the ramp, car park and Marine Rescue building should consider the findings of this CHRMAP.

7.4 Key Assumptions

The timeframes envisaged in the coastal adaptation pathways are not absolute. These timeframes are related to the current state of local land planning, coastal processes knowledge and climate projections, as outlined in the CHRMAP. Therefore, the timeframes are typically not worst-case scenarios but instead consider risk-adjusted and/or consensus-based adjustments and quantifications. Other options may be envisaged, particularly if land planning practices, coastal processes knowledge or climate projections are changed. Therefore, the implementation pathway will evolve overtime.

The options have been selected based on information gathered through all the previous CHRMAP project stages. Although the Multi-Criteria Analysis and Cost Benefit Analysis have been key gateway decision points for selecting options. The preparation of the MCA and CBA required interpretation and approximations, particularly regarding the criteria and cost quantifications, and have limitations. Also, the proposed options have been developed only at a conceptual level to compare several options.

The CHRMAP proposed options should be the subject of further investigations, surveys, policy review, environmental impact investigation, development approval and authorities' endorsement, local stakeholder and community engagement, preliminary design, detailed design, costing and any other applicable preparation work required before implementation. The options should be optimised and modified following such additional investigations.

An example of this could be changes to Management Unit boundaries to address priority areas, optimise option effectiveness, and reduce costs. It may also be practical to develop a staged implementation approach to some of these management actions to test their effectiveness and refine subsequent stages' design (e.g., staged installation of works). It is recommended that further work is undertaken to identify priority sections of MUs and consider the use of composite treatment options in these MUs. This may mean that some sections of the current MUs are being managed in different ways rather than having one option for the whole MU. Appropriate supporting analysis is needed to propose preferred treatment options on smaller sections of coastline than the MU's presented in this CHRMAP, as the cost-benefit analysis has considered these boundary extents and quantities.

It is anticipated that the current MU's could be further split based on the projected hazard extents and predominant foreshore use.

7.5 Further Investigations

Information gaps identified in the CHRMAP should be addressed early. Some of these gaps can be closed by the collection of data, as discussed previously in Section 7.3. Other information gaps can be closed during the preliminary and/or detailed design phase when specific or detailed analysis of available data, information, modelling, and projections are carried out.

The following investigations are recommended:

1. Preparation of an Asset Management Plan to identify existing infrastructure and recreational facilities in the coastal erosion hazard zone and provide direction to:
    a. Progressively relocate non-critical assets (PMR2) away from the coastal hazard zone once they reach the end of asset life or replace assets with suitably durable and/or sacrificial infrastructure. This may include vulnerable car parks, recreational amenities, and access structures such as ramps, stairs, paths, etc.
    b. Plan for the relocation of critical service infrastructure outside of the coastal hazard zone once they reach the end of asset life, or at a minimum, modify the service infrastructure asset so that it does not run parallel to the coastline where possible and can be progressively removed when exposed to intolerable risk levels.
2. Investigate opportunities for demarcating a Special Control Area and introducing development restrictions.
3. Heritage Investigation – For MU1 the recommendation to undertake sand nourishment has come from a cost-benefit analysis, which was significantly influenced by the area and unit value of the heritage area. An investigation should confirm the extent and nature of the Heritage site and confirm if the database polygon is representative. The investigation should include consultation to assess the 'value' and confirm appropriate management responses. The erosion hazard maps can be used to inform the scale of the investigation.
4. Sand source feasibility study – MU 1 has recommended sand nourishment as the preferred option. Subject to the Heritage Investigation confirming the need for substantial protection by sand nourishment, a feasibility study should be undertaken on sand sourcing. Unfortunately, the availability of suitable sand for beach nourishment works is not well understood in the study area. It is recommended that a sand source feasibility study is undertaken to determine the capacity and cost of utilising local sand supplies. This study should focus on nearby land-based sand sources and evaluate potential environmental impacts and approvals required. Cost estimates used in this CHRMAP have assumed that a reliable source of sand in reasonable proximity to the study area may be available. If this assumption is incorrect, costs may increase and affect the CHRMAP recommendations.

5. Prepare a Foreshore Management Plan (FMP) for the study area. This can increase the protective capacity of the natural dune system, and the future provision of an adequate coastal foreshore reserve for public access and use should be considered. The FMP should address:
    a. The requirements of SPP2.6 and its supporting documentation.
    b. The findings of this CHRMAP.
    c. Potential environmental issues such as biodiversity and environmental impacts and detail a weed management strategy for the coastline.
    d. Incorporate findings of Asset Management Plans as appropriate.
    e. Include a review of existing beach access points, ensuring appropriately fenced and signed paths, and signage for dune repair.
    f. Develop an education strategy for coastal and environmental management. The strategy should work to inform the community about the CHRMAP and FMP and their findings. The education strategy should also include appropriate on-ground signage and information for beach access.
    g. Monitor impacts of general beach access on nesting habitats and migratory bird species in dune areas.
    h. Include recommendations for any changes to beach access points, delivering appropriately fenced and signed paths, signage for dune repair and clear signage for 4-wheel drive access and permissibility, including consideration of the need to separate 4-wheel drive access and pedestrian access points.
    i. Monitor impacts of 4WD vehicles (where applicable) and general beach access on nesting habitats and migratory bird species in dune areas.
    j. Determine the need for a bush fire management plan for the dune and coastal areas.
6. Community education – Develop an education strategy for coastal and environmental management. The strategy should work to inform the community about the CHRMAP and FMP and their findings, as well as use suitable engagement methods such as infographics and FAQs. The education strategy should also include appropriate on-ground signage and information for beach access, camping and 4-wheel driving, where applicable. Coastal hazard maps should be shared with the community to raise awareness and promote community education of the issue and consider advocating to other organisations regarding statewide promotion of a coastal hazard community education program. Such mapping could become a vital knowledge-building tool for the community coming to terms with increasing coastal hazards.

7.6 Implementation Plan

The coastal adaptation pathway includes short-term (0-15 years), medium-term (15-30 years), and long-term (30-100 years). Detailed implementation plans for MU 1 to MU 4 are presented in Table 7-1 and Table 7-2. The plans are presented in order of timing, with short-term actions stated before medium to long-term actions. An overview map of the Study Area and Management Unit locations is provided in Figure 7-1 below for reference. For each Management Unit, short-term coastal management actions (i.e., “options”) were designed to be compatible with medium and long-term adaptation actions.

No on-ground works are recommended for the study area in the short term.

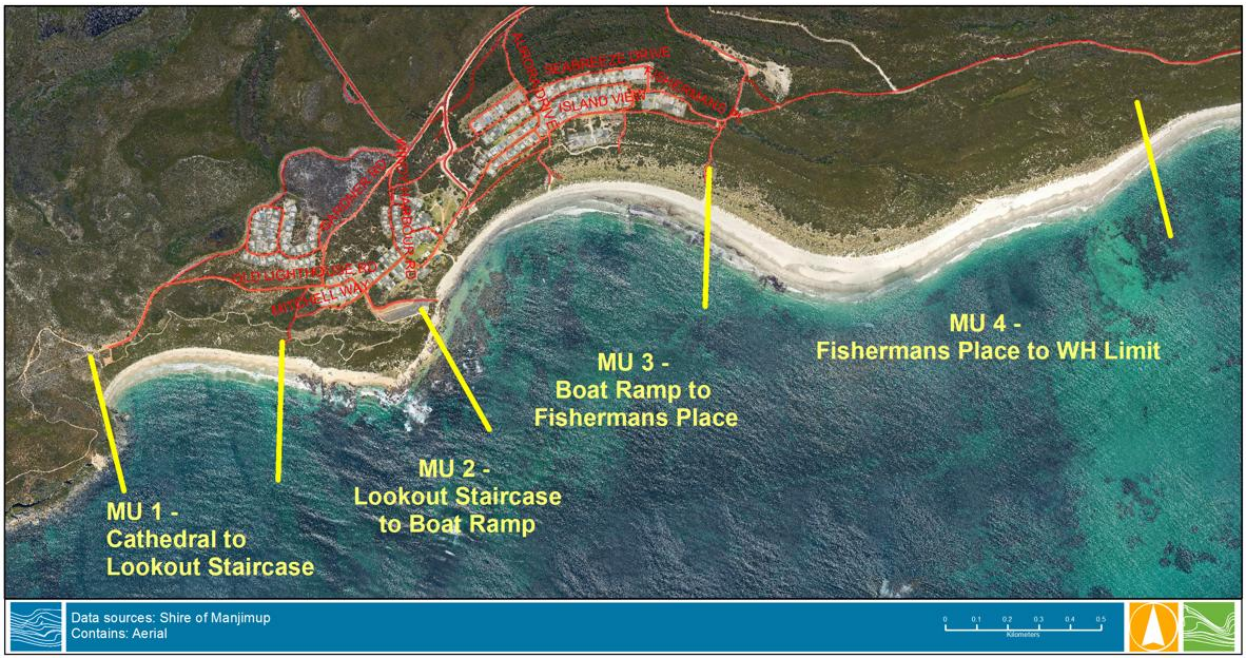

Figure 7-1 Management Units for Windy Harbour

Medium-term (15-30 years) and long-term (30-100 years) implementation provides a strategic consideration of how the Shire will adapt to long-term climate change impacts. Therefore, medium- and long-term implementation are not described in detail in the CHRMAP. Longer-term responses include:

- Continue to take action on the revised planning instruments implemented in the short term.
- Providing temporary/interim hazard protection may also become more costly, and a change in the adaptation pathway may be required. For example, as the sea level rises, it is possible that options for using sand or rock resources to protect assets near the coast may become economically unsustainable.
- Implementing planned managed retreat if protection is found not to be feasible.

Long-term adaptation strategies/pathways have been recommended for each MU for erosion that will allow for the continuous function of local communities whilst accommodating the increasing burden of coastal hazards. The long-term strategy informs future planning instruments, supports monitoring, recommends planning reviews and underpins collaboration between coastal land managers, stakeholders and the community.

The primary coastal management actions for mitigating erosion hazards at Windy Harbour are:

- **Avoid locating assets in areas that will be vulnerable to coastal hazards (AV) for MU4**. As this area is undeveloped land, there are no built assets, and no environmental or heritage assets are identified as unique to this MU. The primary recommendation for the whole MU is to avoid locating assets in vulnerable areas. Future development could be possible with appropriate setbacks. As the Shire is likely to have a limited budget for coastal management in general, it is recommended that this MU is allowed to retreat naturally. Monitoring the evolution of the coast should be the focus in the short term. This MU could ultimately be used as a harvest area or sand nourishment back passing area to undertake beach nourishment in the other MUs.
- **Planned / Managed Retreat via Demolition/removal/relocation of assets from inside hazard area (PMR2) for MU2 and MU3**. Preparation for this option should focus on monitoring the evolution of the coast and asset management planning for public infrastructure. In MU2, in the short-term, built assets are primarily beach access paths and steps. In MU3, the short-term infrastructure includes the boat ramp, beach tractor parking, beach boat launching areas, and pedestrian and vehicle beach access. Short-term

management should focus on these items. As the built assets projected to be impacted by erosion first are public assets strategic planning should be undertaken to identify appropriate locations for their replacement and/or suitable temporary accommodation strategies until such time that the asset is relocated. Alternatively, beach nourishment (see below) could be used to protect smaller priority sections of these MU's as required, and local scale temporary works could also be considered on a case-by-case basis depending on how the coast evolves and assets become threatened/impacted.

- **Protection via Beach Renourishment (PR1) for MU1**: Undertake works as necessary to prevent asset erosion. This is anticipated as relatively small-scale works to maintain approximately the same level of beach and foreshore amenities currently experienced. Larger-scale works with additional foreshore vegetation rehabilitation could occur if significant storm damage occurs or pre-emptive works are preferred. If more frequent management works are undertaken, the sandy beach could be rebuilt as required with small beach width amounts and volumes. The CBA analysis allowed for the placement of sand on the upper beach face and dunes (example shown in Figure 7-2) across the entire length of each MU (585m) to re-establish the sandy beach and provide an erosion buffer to existing assets. Monitoring will likely identify smaller priority sections of this MU, allowing for smaller targeted work campaigns rather than nourishment across the entire MU.

Figure 7-2 Beach nourishment underway at Sunshine Coast, QLD

Table 7-1 Implementation plan for all MUs – recommendations are in Priority Order

Recommendation	Notes	Responsibility	Trigger	Possible funding source(s) and Cost (if known)	Present Day to 2032	2032-2072	2072-2122
Review and update the Windy Harbour Management Plan	■ The term of the Windy Harbour Management Plan has expired, and an update is required	■ LGA	■ Immediate	■ Operational ■ Grants ■ $35,000	X		
INVESTIGATIONS	■ Asset Management Plan ■ Foreshore Management Plan	■ LGA	■ Completed CHRMAP	■ Operational ■ Grants ■ $100,000	X		
Locating assets in areas that will not be vulnerable to coastal hazards (AV)	■ Item cost for investigations and update of the Windy Harbour Management Plan to identify appropriate areas for future development.	■ LGA	■ Completed CHRMAP	■ Operational ■ $50,000	X	X	X
Prevention of further development (PMR3)	■ Investigate opportunities in the context of planned and managed retreat. ■ Source legal advice for review of lease agreements and preparation of amendments to address coastal hazard risks. ■ Prepare an update of the Windy Harbour Management Plan and/or introduce Local Planning Policy; an amendment to Special Use Zone No.5 and/or introduction of a Special Control Area. ■ Item cost for investigations and management plans.	■ LGA ■ Can seek support and assistance from DPLH, WALGA	■ Completed CHRMAP	■ Operational ■ Grants ■ $100,000	X	X	X
Monitoring (NR1)	■ Routine beach and dune survey every year and corresponding photos. ■ Maintaining ongoing State monitoring activities. ■ Occasional event-based monitoring following storm erosion events.	■ LGA ■ DoT ■ BOM	■ Completed CHRMAP ■ Severe storm event(s)	■ Operational ■ Grants ■ $15,000 annually	X	X	X
Demolition/removal/relocation of asset from inside hazard area (PMR2)	■ Maintenance assumes ongoing allowance for foreshore reserve. ■ Removal / Relocation of assets as required, and subsequent land improvement cost to return land to undeveloped foreshore reserve, ■ Asset management planning and monitoring will identify assets with unacceptable vulnerability. ■ Not applicable to MU4, as no built assets were identified as vulnerable.	■ LGA	■ Monitoring	■ Operational ■ Grants ■ Cost to be determined after Asset and Foreshore Management Plans	X	X	X
Leaving assets unprotected (PMR1)	■ For low-value public assets to provide ongoing allowance for foreshore reserve. ■ Assumes a clean-up rate following damage/loss.	■ LGA	■ Storm damage ■ Asset and Foreshore Management Plans	■ $25,000 ■ (Plus 4% annual maintenance of $1,000)	X		

Recommendation	Notes	Responsibility	Trigger	Possible funding source(s) and Cost (if known)	Present Day to 2032	2032-2072	2072-2122
CHRMAP Review	■ Review at least every 10 years.	■ LGA	■ Completed CHRMAP	■ Operational ■ Cost to be determined based on scope of changes / updates required		X	X

Table 7-2 Implementation plan with specific recommendations for each MU

Recommendation	Notes	Responsibility	Trigger	Possible funding source(s) and Cost (if known)	Present Day to 2032	2032-2072	2072-2122
MU1 Cathedral Rock to Lookout Staircase Recommended Medium- and Long-term pathway to address Erosion is Protection with Beach Nourishment (PR1)	■ **As implementation is not anticipated to be required until 2052, no physical works are required in the short-term.** ■ Preparation for this option should focus on monitoring the evolution of the coast, investigating Heritage values and sand source feasibility and further engagement regarding the community and economic values of the area to prioritise sections of coast for protection. ■ The priority action is to undertake a Heritage Investigation to confirm the nature and extent of the Heritage database entry and the need for protection by sand nourishment. ■ Subject to the results of the Heritage Investigation, a sand source feasibility study should be undertaken to determine the capacity and cost of utilising local sand supplies for beach nourishment. The study should consider sources, grain size, volume, cleanliness, proximity, costs. ■ Ongoing maintenance nourishment campaigns would be required after the placement of capital works.	■ LGA	■ Monitoring ■ Completed CHRMAP	■ Detailed heritage investigation cost is $50,000 ■ Sand Source Feasibility Study approximate cost is $100,000 ■ Approximate beach nourishment economic cost of $10.19 M at NPV 4% which includes valuing the loss of some qualitative assets such as Environmental and Heritage. ■ Expense costs (out of pocket) for the Shire commence in 2052 and are equivalent to $2.0M at NPV 4% to 2122 and include an annual maintenance estimate of approximately $170,000 ■ Operational ■ Grants ■ Direct beneficiaries	Detailed heritage investigation Sand Source Feasibility study	Beach Nourishment	Beach Nourishment
MU2 - Lookout Staircase to Boat Ramp Recommended Short-, Medium- and Long-term pathway to address Erosion is Demolition/removal/ relocation of assets from inside the hazard area (PMR2)	■ Implementation is assumed in the same year as the hazard line identifies land areas as vulnerable, commencing in 2052, for the removal of assets. Environmental foreshore areas are left to be eroded. ■ Preparation should focus on monitoring the evolution of the coast; asset management planning for built infrastructure, including beach access and foreshore paths.	■ LGA	■ Monitoring ■ Updated CHRMAP	■ The approximate economic cost of $4.53 M at NPV is 4%, which includes valuing the loss of some qualitative assets such as environmental and recreational. ■ Expense costs (out of pocket) for the Shire commence in 2052 and are equivalent to $18,000 at NPV 4% to 2122 Operational. ■ Grants		X	X

Recommendation	Notes	Responsibility	Trigger	Possible funding source(s) and Cost (if known)	Present Day to 2032	2032-2072	2072-2122
MU3 - Boat Ramp to Fisherman's Place Recommended Short-, Medium- and Long-term pathway to address Erosion is Demolition/removal/ relocation of assets from inside the hazard area (PMR2)	■ Implementation is assumed in the same year as the hazard line identifies land areas as vulnerable, commencing in 2052, for the removal of assets. Environmental foreshore areas are left to be eroded. ■ Preparation should focus on monitoring the evolution of the coast and asset management planning and relocation for existing built infrastructure, as well as subsequent land improvement costs to return land to undeveloped foreshore reserves. ■ The boat ramp, beach tractor parking, beach boat launching areas, and pedestrian and vehicle beach access have been identified as important local assets. Short-term management should focus on these items. The presented costs do not include an allowance for upgrading or replacing the boat ramp. As the boat ramp function requires it to be in the hazard zone, it will need individual consideration. ■ Alternatively, beach nourishment could be used to protect smaller priority sections of this MU as required, and local-scale temporary works could also be considered on a case-by-case basis depending on how the coast evolves and assets become threatened/impacted.	■ LGA	■ Monitoring ■ Updated CHRMAP	■ The approximate economic cost of $5.82 M at NPV is 4%, which includes valuing the loss of some qualitative assets such as environmental, public infrastructure, lease Cottages, and recreational assets. ■ Expense costs (out of pocket) for the Shire commence in 2052 and are equivalent to $75,000 at NPV 4% to 2122 Operational. ■ Grants ■ Direct beneficiaries ■ Lease land management	X	X	X
MU4 - Fisherman's Place to Windy Harbour limit Recommended Medium- and Long-term pathways to address Erosion are Locating assets in areas that will not be vulnerable to coastal hazards (AV) and Monitoring (NR1)	■ As this area is undeveloped land, there are no built assets, and no unique environmental or heritage assets have been identified. Allowing it to retreat naturally is recommended. ■ The primary recommendation for the whole MU is to Avoid locating assets in vulnerable areas. Future development could be possible with appropriate setbacks. ■ Monitoring the evolution of the coast should be the focus in the short term.	■ LGA	■ Completed CHRMAP	■ There is no anticipated cost for this recommendation. Natural assets will be eroded, but only minor management will be expected after severe storms.	Monitoring	X	X

8 PUBLIC REVIEW AND COMMENT PERIOD

A draft version of this document was released for a public review and comment period finishing in February 2025. No comments were received. While the CHRMAP provides a rationale for coastal hazard management a substantial amount of preparatory work, detailed in the CHRMAP recommendations, is required before “on the ground implementation” can proceed. The CHRMAP is a strategic planning document that considers long timeframes. The next phase of research and studies would consider priority items in more detail, including:

- Community and stakeholder engagement
- Data collection and analysis
- Further preliminary and detailed investigations
- Economic and budgeting analysis to determine accurate costs, once detailed designs are available

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

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