



Hopetoun CHRMAP

Summary Document

Shire of Ravensthorpe

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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 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).

Hopetoun has been identified as potentially exposed to erosion hazard. 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 Hopetoun.

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 region 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 Hopetoun shoreline was divided into three management units (MUs):

- MU1 – Western Beach.
- MU2 – Town Beach.
- MU3 – Esplanade Beach.

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 present day, 2037, 2052 and 2122. It is acknowledged that the hazard identification component of the present study was undertaken to provide a broad understanding of exposure that can support government planning at a regional level. The hazard identification may be superseded by future site-specific studies. Results derived from this study should not be over-interpreted at a micro-scale due to the assumptions applied and the limitations in resolution.

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: Residential, Commercial, Public, Tourism and Environmental. The quantity of each asset category by Management Unit, category and planning horizon are presented for erosion hazard. Inundation has been shown to not impact on any assets other than the marine facility.

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. Engagement outcomes have informed the adaptation planning process. A Community Values assessment was used to identify key values and concerns for the study area.

Key values identified by participants across the whole study area are as follows:

- Preserving ecological systems.
- Using the beaches for things like swimming and walking.
- Access to beaches and foreshore areas into the future.



- Conservation of heritage sites.
- Retention of natural landscapes, not interrupted by structures.

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, for each hazard. Extreme vulnerability to erosion has been identified from the present day onwards in MU2 and across all MUs 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 preliminary as they are based on currently available information. The proposed options should be the subject of further investigations, surveys, policy review, impact investigations (environmental, visual and social), development approval and authorities' endorsement, local stakeholder and community engagement, preliminary design, detailed design, costing and any other applicable preparation work required prior to be implemented. The options should be optimised and modified following such additional investigations.

To address erosion along the Hopetoun coastline, a **combination of Planned / Managed Retreat and Protection with Beach Renourishment** has been shown to be the preferred approach as a result of this analysis.

A number of additional general investigations are recommended:

- Preparation of Asset Management Plans.
- Investigate opportunities for leaseback of land and land swaps in the context of planned and managed retreat.
- **Sand source feasibility study.**
- Foreshore Management Plans (FMPs).
- Community education.
- Update dune, beach (topography) and bathymetry survey data as a priority of the recommended monitoring activities.
- Undertake Benefit Distribution Analysis (BDA).

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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- Appendix C Vulnerability Analysis Chapter Report
- Appendix D Risk Evaluation and Treatment Chapter Report



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1 INTRODUCTION

It is internationally recognised that the mean sea level has been rising globally since the nineteenth century and is projected 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 or permanent), storm erosion and long-term shoreline recession. State governments across Australia have introduced obligations that require 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 potentially vulnerable to coastal hazards. Specific guidelines have been developed to assist this process (WAPC, 2019).

The CHRMAP aims to increase knowledge and understanding of coastal hazard risks and to identify risk management and adaptation measures for implementation. The outcomes of the CHRMAP can inform local and state 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. Overall, this CHRMAP develops a flexible adaptation pathway for the region and serves as a key reference for management, planning and policy-making for the short-term, medium-term, and long-term.

SPP2.6 requires adequate risk management planning 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 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 risk management and adaptation hierarchy outlined in SPP2.6 of *Avoid, Retreat, Accommodate, and Protect*.

“Avoiding the placement of sensitive development within areas that are at risk from coastal hazards provides the most resilience to future coastal hazards. Conversely, using protection structures to allow sensitive development within areas that would otherwise be at risk from coastal hazards provides the least resilience to future coastal hazards.”

WAPC 2019, Coastal hazard risk management and adaptation guidelines – Section 5.1, page 29.

Avoiding risk exposure and retreating from areas exposed to risk are the preferred course of action in the hierarchy, but either response will be challenging to communicate and complex to implement. This is because there is an historical notion that all land currently developed is suitable for development *ad infinitum*; purchase and improvement of land follows by both the private sector and public agencies (including the development of essential services infrastructure). The fact that this may not hold true over long time periods is unlikely to be factored into ownership and development of land, and the financial and social constraints of acting can be significant.

Retreat can be further complicated by the absence of suitable land to retreat to, or the cost of developing such land. As such, policy amendments in local planning provisions to enable this is required.

The study area for this CHRMAP is the entire shoreline within Hopetoun (refer Figure 1-1).



The CHRMAP is delivered over 8 Stages in line with the CHRMAP Guidelines (WAPC, 2019). This report presents Stage 8: CHRMAP project summary.



Figure 1-1 Study Area: Western Beach is Management Unit (MU)1, Town Beach is MU2 and Esplanade Beach is MU3 throughout the report

1.1 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 study area and should be considered in combination with the more detailed technical reports which are provided as appendices. References are provided throughout this document and refer to the documents 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 which are determined according to a set of factors:

- Jurisdiction boundaries,
- Presence of coastal assets and relevant stakeholders,
- Shoreline orientation,
- Natural and manmade shoreline features,
- Points established by geological features and/or localised sediment transport regimes, and
- Coastal processes and potential hazard types.



The Hopetoun shoreline was divided into three management units:

- MU1 – Western Beach.
- MU2 – Town Beach.
- MU3 – Esplanade Beach.



2 ESTABLISH THE CONTEXT

The Establish the Context Chapter Report (Appendix A) outlines the key management and adaptation issues that need to be considered in the CHRMAP, summarised below.

The CHRMAP aims to guide planning for future coastal land use by coordinating decisions and managing risks like coastal erosion and flooding. Coastal land is crucial for the community’s social, environmental, infrastructure, and economic well-being. Although there have been efforts to address coastal hazards, a coordinated plan that identifies and manages areas at risk will help make the community more resilient.

2.1 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 but also providing strategic guidance for medium and long-term measures. This is achieved by following the process as outlined in (Figure 2-1).

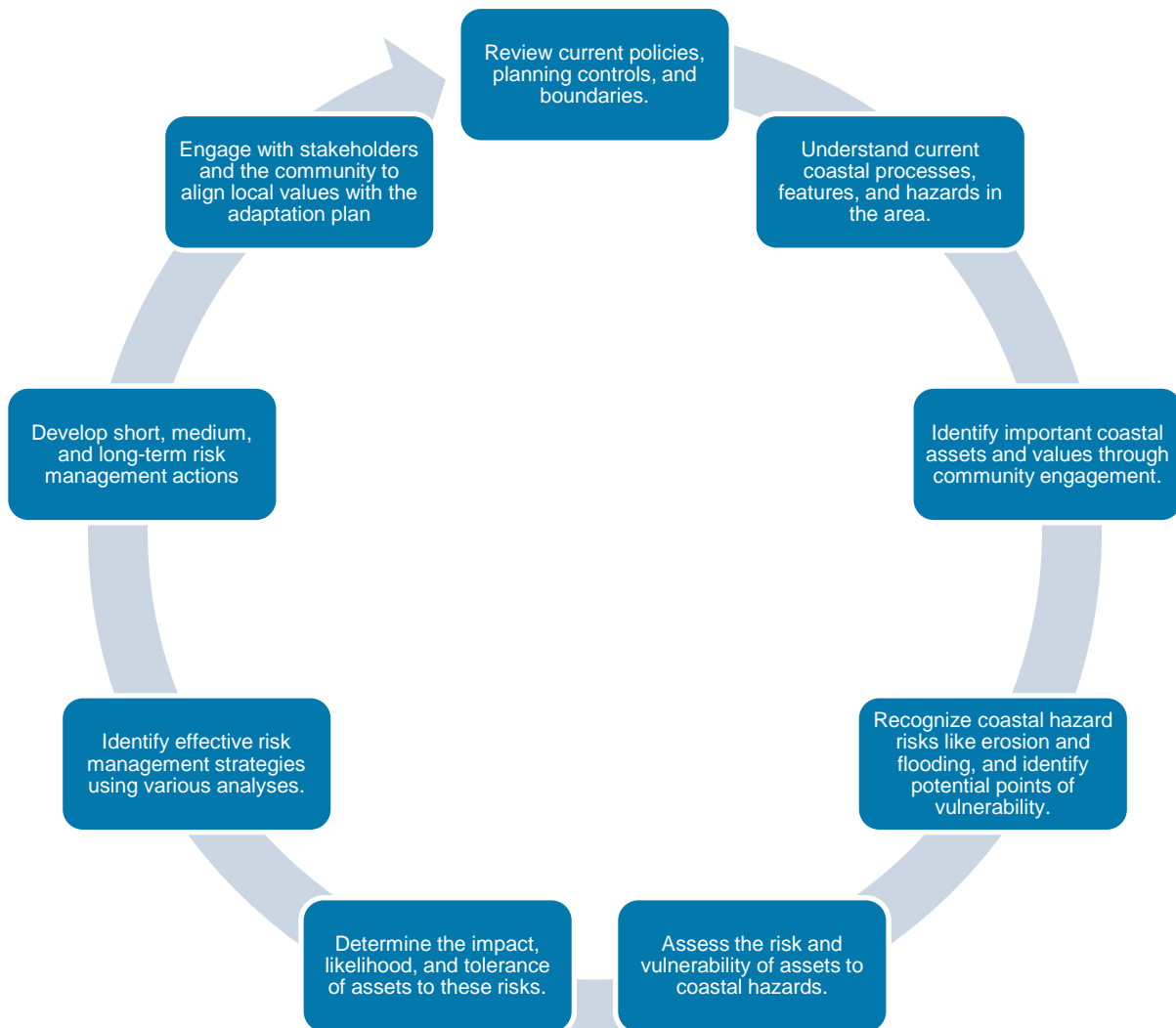


Figure 2-1 CHRMAP process



2.2 Local context

Hopetoun is a small town located on the southern coast of Western Australia, within the Shire of Ravensthorpe. It lies about 600 km southeast of Perth and features various coastal landscapes such as sandy beaches, rocky formations, and offshore reefs. The town was established in 1900 to support the Philips River gold field and later became a shipping port for the mining industry. As of the 2016 census, Hopetoun's population is 871, down from 1,398 in 2011, due to the closure of the Ravensthorpe Nickel Mine. However, the population increases significantly during holiday periods.

The study area includes three segments of shoreline:

- **Western Beach (West-Facing Shoreline, Management Unit MU1):**
 - **Location:** Bounded by Flathead Point to the east.
 - **Characteristics:** Exposed to offshore swells with minimal protection from an offshore ridge. The foreshore is wide with dense vegetation, and beach access points are visible at intervals of a few hundred meters.
 - **Erosion Risk:** Natural processes dominate foreshore movements, with additional impacts from geophysical conditions. According to Seashore (2019), this area could become an erosion hotspot due to future sea level rise (SLR).
- **Town Beach (South-Facing Shoreline, Management Unit MU2):**
 - **Location:** Bounded by Flathead Point to the west and Mary Ann Point to the east.
 - **Characteristics:** Shows significant impacts from the marine facility. The foreshore includes various infrastructure elements such as the old and new boat ramps, tyre revetment, car park, beach access points, public facilities, service jetty, and marine structures over the reef.
 - **Erosion Risk:** A review by Advisian (2019) noted a potential reversal of littoral drift direction in the mid-section. The foredune here is narrow, and Seashore (2019) identified it as an erosion hotspot. Assets near or landward of the foredune could be vulnerable to coastal erosion.
- **Esplanade Beach (Shoreline East of Mary Ann Point, Management Unit MU3):**
 - **Location:** Extends east from Mary Ann Point.
 - **Characteristics:** Exposed to refracted swells from the southeast. The foreshore reserve widens gradually toward the east and is backed by Esplanade Road.
 - **Erosion Risk:** No previous erosion issues have been reported for this segment.

The town of Hopetoun, with its diverse coastal landscapes, faces varying degrees of coastal erosion risk across its shoreline segments. The CHRMAP addresses these risks, focusing on areas identified as vulnerable to erosion and considering both public and private assets. The plan aims to protect and manage the coastline sustainably, ensuring the long-term resilience of the community and its assets.

2.3 Existing planning controls

Planning in Western Australia is guided and regulated by the State Planning Framework, which includes strategic and statutory planning functions set out in the Planning and Development Act 2005. The planning system is hierarchical, requiring increasing levels of detail as a proposal progresses through the state and local planning systems, including subdivision and development of individual sites. A summary of information from the planning documents relevant to the coast is included in Table 2-1 below.



Table 2-1 Summary of relevant planning framework

Framework	Document	Purpose	Key Considerations for CHRMAP
State Planning Controls	Planning and Development Act 2005	Provides the power to prepare State Planning Policies and Local Planning Schemes	
State Planning Controls	State Planning Strategy 2050	Notes the challenge of vulnerable coastlines at risk and the need to implement adaptation strategies in anticipation of sea level rise and extreme weather events	Preparation of the Hopetoun CHRMAP responds to the environmental aspiration of ' <i>Risk management strategies continue to be developed and adopted for natural hazards in the context of climate change patterns and trends.</i> '
State Planning Controls	Planning and Development (Local Planning Schemes) Regulations 2015	Defines the objectives for local scheme zones and reserves to be applied through the local planning scheme	The Hopetoun CHRMAP may make recommendations for changes to land use zones and reservations to reflect the suggested adaptation option.
State Planning Controls	WA Coastal Zone Strategy	Ensure that coastal development is sustainable in the long term and meets community, economic, environmental and cultural needs	The development of the Hopetoun CHRMAP will address the Shire's responsibility to meet the strategy's principles. The Strategy also notes that ' private parties are responsible for managing risks to their private assets and incomes. ' The CHRMAP should also align with the strategy's adaptation hierarchy. Protection, being the last resort option, is based on the principles of 'beneficiary pays' for protection measures.
State Planning Controls	State Planning Policy 2.6 – Coastal Planning	Guides decision making in relation to planning along the state's coastline and stipulates the requirement for the preparation of this CHRMAP.	Hopetoun has been identified as an 'erosion hotspot', therefore this CHRMAP is being prepared in line with SPP2.6 to address the identified risk
State Planning Controls	Coastal Hazard Risk Management and Adaptation Planning Guidelines 2019	These guidelines provide the framework for preparing a CHRMAP.	These guidelines will be used in the development of the CHRMAP, inform the approach to community and stakeholder engagement and the preparation of this document.



Framework	Document	Purpose	Key Considerations for CHRMAP
State Planning Controls	CHRMAP Guidelines Appendix 4: Planned or Managed Retreat Guidelines	Provides guidance on implementing planned or managed retreat policy measures for brownfield and infill development.	Adoption of guidelines if planned or managed retreat is proposed as a policy option.
Regional Planning Controls	Goldfields-Esperance Regional Planning and Infrastructure Framework	Provides the regional context for land use planning in the region, an overview of regional issues, identify priority actions and indicate regionally significant infrastructure projects.	The CHRMAP addresses the proposed action within the document for the Shire of Ravensthorpe to prepare a coastal management vulnerability and risk assessment study.
Local Planning Controls	Shire of Ravensthorpe Strategic Community Plan 2014-2024	Sets the vision and aspiration for the Shire and provides the basis for much of the Shire's decision making	No specific strategies or actions which need to be addressed in the CHRMAP, however it should acknowledge the importance of tourism in coastal areas of the Shire. Community engagement will further confirm the understanding of tourism and its importance (value) to the community of Hopetoun.
Local Planning Controls	Local Planning Strategy (2015)	Provides a framework for development over the next 15-20 years and informs the development of the local planning scheme	The CHRMAP should recognise the importance of tourism to the Shire and any implications it may have on tourism land uses as well as protection of natural assets which are a key driver for tourism in this area. Future updates to the Local Planning Strategy should reference the CHRMAP and recommended planning actions.
Local Planning Controls	Local Planning Scheme No. 6	Provides the statutory framework for managing land use and development within the Shire	The scheme text does not include any requirements or provisions relating to this area of coast or the scheme reserves in this area. In accordance with the objective of the environmental conservation reserve, these areas are to be protected from development and subdivision. The CHRMAP will need to consider the planning zones and reserves in the scheme and the role they play in the protection of natural assets as well as enabling development in this coastal town.



Framework	Document	Purpose	Key Considerations for CHRMAP
Local Planning Controls	Shire of Ravensthorpe Coastal Management Plan (CMP) 2011	Provides a plan for managing the Shire's coastal reserves	The CMP provides action plans for four coastal sectors. Sector 2 (Hopetoun Beaches) are applicable to the Hopetoun CHRMAP. Whilst the CMP includes recommendations that are more detailed than those included in a CHRMAP, these recommended actions should be reviewed to determine if they are still applicable.
Local Planning Controls	Shire of Ravensthorpe heritage list	Indicates a number of local heritage sites to be considered for this CHRMAP	The CHRMAP will need to consider the implications of coastal processes on these sites.
Local Planning Controls	Local Policy WS 6 Conservation of Flora and Fauna	A wide policy to ensure the maintenance of natural bush reserves.	Coastal vegetation is considered a form of natural bush reserve and therefore should be continuously maintained in accordance with the policy.



2.4 Community and Stakeholder Engagement

Key to the success of the CHRMAP project is to ensure that the adaptation plan is underpinned by community and stakeholder values and knowledge. To this end, a Community and Stakeholder Engagement Plan was developed in order to identify relevant stakeholders and determine the structure and pathways for their engagement throughout the CHRMAP process (Appendix E).

A summary of engagement activities undertaken to achieve the overarching objectives of the community and stakeholder engagement plan for the CHRMAP is provided below:

- Stage 1: Establish the Context: Coastal values online survey and feedback sought at an in-person community event to understand the community's coastal values, February-March 2022:
 - The top five values that were identified as being strongly valued were:
 - Preserving ecological systems (92%)
 - Using the beaches for things like swimming and walking (83%)
 - Access to beaches and foreshore areas into the future (83%)
 - Conservation of heritage sites (77%)
 - Retention of natural landscapes, not interrupted by structures (64%)
 - The top five management responses were:
 - Preserve coastal dunes and vegetation (70% strongly agree)
 - Advise landowners about the risk of erosion when purchasing or developing in hazard areas (67% strongly agree)
 - Retain public access to beaches and foreshore areas (64% strongly agree)
 - Do not allow more development in hazard areas (55% strongly agree)
 - Leave seaweed in place to lower the risk of coastal erosion (45% strongly agree)
 - Allow land to be used in developed areas until impacted (45% agree)
- Stage 5: Risk Evaluation: Survey and Community workshop to seek feedback from the community on the adaptation options, May – July 2023:
 - No community members or stakeholders attended the workshop. Three responses were received for the survey with no clear trends in these responses and due to the low number, no MCA scoring was changed as a result. Instead, scoring did consider the coastal values identified as part of the Stage 1 engagement works.
- Stage 8: Draft CHRMAP: Written submissions to seek feedback from the community on the draft CHRMAP.

2.5 Success Criteria

The values collated from the engagement has been used to generate the success criteria for the CHRMAP. These values will be key to the whole CHRMAP as they will ultimately drive the selection of adaptation options. The success criteria for the Hopetoun CHRMAP are:

- Preserving ecological systems,
- Conservation of heritage sites,
- Maintenance of access to beaches and foreshore areas into the future,



- Continued use of beaches for recreational activities,
- Retention of natural landscapes, not interrupted by structures,
- Protection of the access to facilities such as toilets, showers, picnic and BBQ facilities, and
- Protection of the waterfront infrastructure such as boat ramps and jetties.



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 for present day, 2037, 2052 and 2122.

One of the main goals of the State Planning Policy 2.6 (SPP 2.6) is to establish a coastal foreshore reserve. This reserve is a designated area of land between the ocean and developed land. Its purpose is to serve various important functions and values, including:

- **Geomorphological Integrity:** Maintaining the natural shape and features of the coastline.
- **Biodiversity:** Preserving plant and animal life.
- **Heritage:** Protecting historical and cultural sites.
- **Public Ownership and Access:** Ensuring that the public can use and enjoy the coastal areas.

The coastal foreshore reserve should be large enough to:

- **Mitigate Coastal Hazards:** Help manage and reduce risks from coastal erosion and storm surges.
- **Allow for Coastal Processes:** Support the natural changes and stability of the coastline.
- **Adapt to Climate Change:** Provide space for adjustments in response to rising sea levels and other climate impacts.

The coastal foreshore reserve is a vital part of managing and adapting to coastal hazards as outlined in SPP 2.6. When assessing the area, considerations include:

- **Allowances for Coastal Erosion:** Ensuring there is enough space to accommodate the natural movement and erosion of the coastline.
- **Storm Surge Inundation:** Planning for areas that might be temporarily flooded during severe weather events.

By incorporating these factors, the coastal foreshore reserve helps protect the land and infrastructure behind it, ensuring long-term resilience and sustainability for coastal communities.

The Hopetoun coastline features a mixture of sandy, rocky, and artificially hardened shorelines. It is a reasonably complex shoreline with various types of coastal hazards present in this region. It is acknowledged that the hazard identification component of the present study was undertaken to provide a broad understanding of exposure that can support government planning at a regional level - and will be superseded once site-specific studies become available. Results derived from this study should not be over-interpreted at a micro-scale due to the assumptions applied and the limitations in model resolution. More detailed risk assessments and analysis may be required for the development of detailed engineering measures for specific sites.

3.1 Erosion Hazard Assessment Method

A desktop review of available information was undertaken, including local metocean conditions, coastal processes, existing coastal monitoring and management and existing coastal hazard information.

The coastal erosion hazard assessment considers the following components:

- **Storm erosion in response to storm waves and loss of beach material.** This is considered a present-day risk as a storm could develop at any point in time. This component is also referred to as S1 Erosion.



- Long-term historic shoreline movement that considers the ongoing evolution of the coast. This could be contributed by littoral drift processes, larger scale morphological movements, long-term water level/wave dynamic variations and climate change impacts. This component is also referred to as S2 Erosion.
- Estimated erosion response to future sea level rise. This component is also referred to as S3 Erosion.

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 from. In this assessment HSD has been determined by the elevation of the 100-year ARI Peak Steady Water Level at individual locations around the study area. The resulting erosion hazard across the study area and across the various timeframes is presented in (Figure 3-1).

3.2 Inundation Hazard Assessment Method

The allowance for the extent of coastal inundation has been calculated as the maximum extent of storm inundation in 2122. The mapping (Figure 3-2) shows that there are very limited inundation impacts apart from the Marine Facility. Because the marine facility is managed separately by DOT under a separate asset management plan, inundation has not been considered further throughout the CHRMAP.



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Figure 3-1 Erosion Hazard Lines



Figure 3-2 Inundation Area for Hopetoun



4 VULNERABILITY ANALYSIS

Assets at risk of coastal erosion are identified and assigned a vulnerability rating. Inundation has not been considered further due to the limited impact on assets other than the marine facility that is managed separately by DOT. The vulnerability results are presented in full in the Vulnerability Analysis Chapter Report (Appendix D). A summary of the results is presented below.

4.1 Asset Classifications

At the time of identification, each asset was categorised into a classification. This streamlines the adaptation planning process in subsequent phases of the project. The study team grouped assets as follows:

- Commercial
 - This includes shops, businesses, offices etc.
 - Corresponding Local Planning Scheme zones are: General industry, Light industry, and Mixed Use.
- Public
 - This item mainly relates to public infrastructure, and includes the marine facility and its structures, and public parks.
 - Corresponding Local Planning Scheme zones are: Strategic Infrastructure (marine facility), Public Open Space, Public Purposes, and Primary / Local Roads.
- Tourism
 - This includes the Hopetoun Beachside Caravan Park, and another area along Templetonia Drive zoned as Tourism in the Local Planning Scheme.
- Residential
 - Private houses and apartments and supporting structures such as sheds and garages.
 - Corresponding Local Planning Scheme zones are: Residential and Rural Townsite.
- Environmental
 - A large area of the foreshore is classified as Environmental Conservation within the Local Planning Scheme.
 - Jim McCulloch Park is located within the Environmental Conservation zone.

4.2 Identified Assets

The impact on assets over the various erosion timeframes is presented in Figure 4-1 with a detailed description below.

Western Beach

A west facing shoreline (“Western Beach”) bounded by Flathead Point to the east. This segment of shoreline is exposed to offshore swell showing minimal impacts from the offshore ridge. There is a wide foreshore with dense vegetation growth. Beach accessways are at an interval of a few hundred metres. Foreshore movements are dominated by natural processes with additional impact from geophysical conditions.

The assets at risk in this management unit are:

- Public: Primary/Local roads and Public Open Space.



- Tourism: Hopetoun Beachside Caravan Park and another area along Templetonia Drive zoned as Tourism in the Local Planning Scheme.
- Residential: one residential land parcel, however, it should be noted that 14 dwellings are impacted within the one parcel. As such, this has been counted as 14, as otherwise the risk would be under-represented for this location.
- Environmental: Beach and coastal vegetation

Town Beach and Boat Ramp

A south facing shoreline (“Town Beach”) bounded by Flathead Point to the west and the Mary Ann Point to the east. This stretch of shoreline shows notable impacts from the marine facility. The foreshore comprises some in-use/not-in-use infrastructure such as the old boat ramp, the tyre revetment, car park, beach accessways, public facilities (toilet etc.), new boat ramp, service jetty, marine facility constructed over the reef. The foredune is narrow over this segment of shoreline. Assets near/landward of the foredune could be vulnerable to coastal erosion risk.

- Commercial: Five Commercial lots.
- Public: Strategic Infrastructure (marine facility) plus adjacent recreational area including the car park, and Primary / Local Roads.
- Tourism: south facing area of Hopetoun Beachside Caravan Park.
- Residential: Properties zoned as Residential and Rural Townsite in the Local Planning Scheme.
- Environmental: Beach and coastal vegetation.

Esplanade Beach

Shoreline to the east of Mary Ann Point (“Esplanade Beach”). A long stretch of shoreline exposed to refracted swell from the southeast. The foreshore reserve gradually widens towards the east, backed by the Esplanade Road. No previous erosion issue has been reported along this segment of shoreline:

- Commercial: mixed use areas.
- Public: Public Purposes (park facilities), and Primary / Local Roads.
- Residential: Residential and Rural Townsite.
- Environmental: Beach and coastal vegetation; Jim McCulloch Park is located within the Environmental Conservation zone.



Figure 4-1 Assets at erosion risk



4.3 Vulnerability Assessment 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 its exposure to the hazard, its 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 4-2; the input components are displayed in blue.

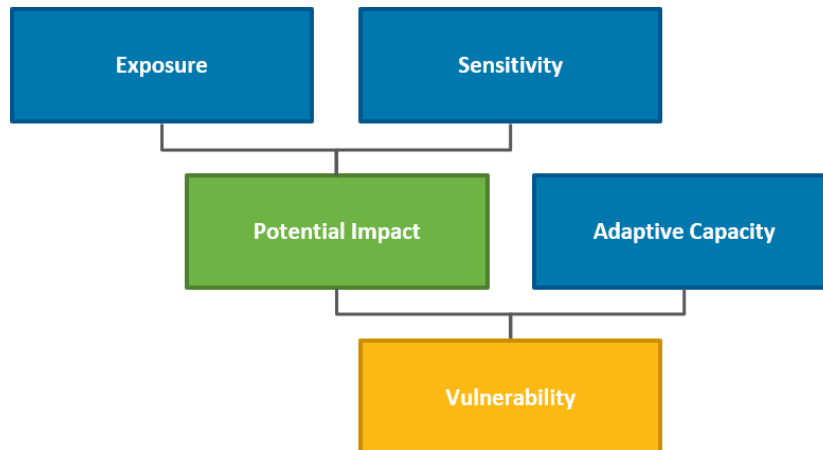


Figure 4-2 Vulnerability assessment components (reproduced from Allen Consulting, 2005)

The **exposure / likelihood** of identified assets represents the likelihood of coastal hazards impacting on an asset. That is, the chance of erosion and / or storm surge inundation impacting on 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 the asset's function and the criticality of the service it provides.

Risk level, or **potential impact**, is calculated as the **product** of exposure and sensitivity (Figure 4-3). 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 from 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 4-3). As per WAPC (2019), four levels of vulnerability are considered in this study which should be assessed for each of the planning timeframes considered by this CHRMAP. **Vulnerability** ratings are Extreme, High, Medium and Low.

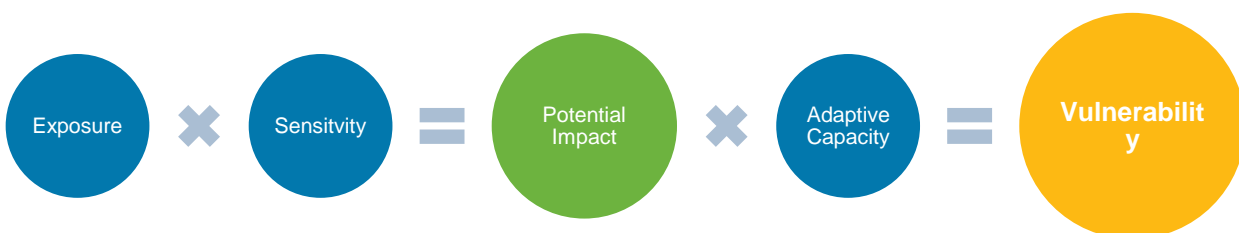


Figure 4-3 Vulnerability relationship



4.4 Results

Using the methodology described above the overall vulnerability ratings for each category within each management unit for each planning horizon were assigned and are presented in Table 4-1 for erosion. There are very limited inundation impacts apart from the Marine Facility.

High erosion vulnerability has been identified from the present day onwards, with already one extreme identified in MU2 for residential. The most vulnerable asset category from the present day across all MUs is Environmental. The assets predicted to be at extreme risk in future timeframes are: Residential, Public and Commercial (due to the limited adaptative capacity and high sensitivity) and Environmental (due to the high likelihood).



Table 4-1 Erosion vulnerability ratings, grouped by management unit & planning horizon

Management Unit	Present Day	2037	2052	2122	Summary
MU1 – Western Beach					
Commercial	-	-	-	-	<ul style="list-style-type: none"> Adaptation planning should commence from the present day for Residential assets Environmental (Beach and Foreshore) assets will likely become a priority for present day to 2037 Public assets will likely be a priority by 2052
Public	Medium	Medium	High	Extreme	
Tourism	Medium	Medium	Medium	Medium	
Residential	High	High	Extreme	Extreme	
Environmental	High	Extreme	Extreme	Extreme	
MU2 – Town Beach					
Commercial	Medium	High	Extreme	Extreme	<ul style="list-style-type: none"> Adaptation planning should commence from the present day for Residential assets Environmental assets (Beach and Foreshore) and Public assets (boat ramp, roads and car park) will likely be a priority for present day to 2037
Public	High	Extreme	Extreme	Extreme	
Tourism	Medium	Medium	Medium	High	
Residential	Extreme	Extreme	Extreme	Extreme	
Environmental	High	Extreme	Extreme	Extreme	
MU3 – Esplanade Beach					
Commercial	Medium	Medium	High	Extreme	<ul style="list-style-type: none"> Adaptation planning should commence from the present day for Residential and Environmental (Beach and Foreshore) assets Commercial assets will likely be a priority by 2052 Public (roads and park) assets will likely be a priority by 2037
Public	Medium	High	Extreme	Extreme	
Tourism	-	-	-	-	
Residential	High	High	Extreme	Extreme	
Environmental	High	Extreme	Extreme	Extreme	



5 RISK EVALUATION AND TREATMENT

A Risk Evaluation and Treatment Chapter Report (Appendix E) 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 and therefore all MUs need to be considered for risk treatment options. Adaptation options are considered following the risk management and adaptation hierarchy (WAPC, 2019; Figure 5-1). Maintaining public access to the coast in developed areas is one of the main objectives of SPP2.6.

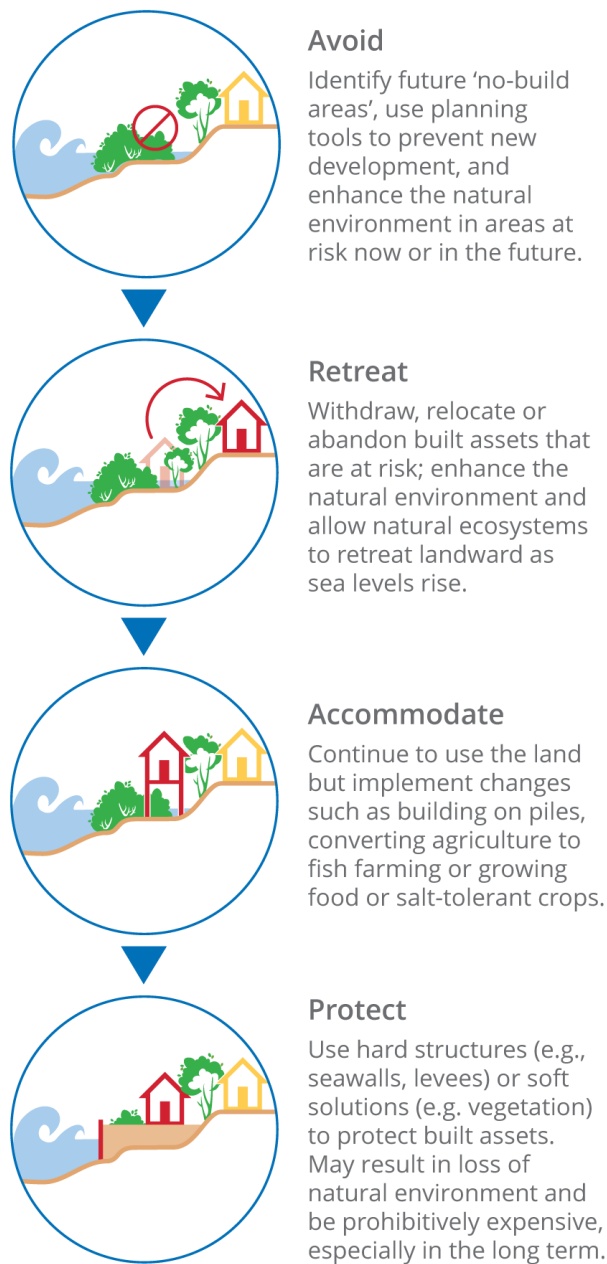


Figure 5-1 Risk management and adaptation hierarchy, as depicted in the WAPC Coastal hazard risk management and adaptation planning guidelines (2019)



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.
- Adaptation options should follow the adaptation hierarchy of Avoid, Retreat, Accommodate and Protect.
- 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, and
 - 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 the use of planning instruments, including managed retreat.

5.1 Multi Criteria Analysis

A catalogue of adaptation options is presented in WAPC (2019). A Multi-Criteria Analysis (MCA) was undertaken to assess suitable adaptation options for Hopetoun. The MCA assessment criteria were as follows:

- Effectiveness
 - 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 wider study area/ Management Unit vision.
- Cost
 - Upfront capital costs.
 - Ongoing maintenance costs.
 - Economic affects – such as loss of businesses, income, 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.

5.2 Results

The MCA results are a rating from negative, neutral to positive. The adaptation options that are recommended for further investigation in a Cost Benefit Analysis (CBA) are any options with a rating of zero and above. Separate to the score applied in the MCA for option costs, the CBA considered the costs and benefits of specific options, presented as the net present value (NPV). The CBA allows direct comparison to aid selection of a preferred option.

The following options received a positive score in the MCA and were progressed into the CBA stage:

- Locating assets in areas that will not be vulnerable to coastal hazards,
- Leaving assets unprotected,
- Demolition / removal / relocation of assets from inside hazard area,
- Prevention of further development / prohibit expansion of existing use rights,
- Voluntary acquisition,
- Beach nourishment or replenishment,
- Monitoring,
- Protection Structure Audit, and
- Notification on title.

In addition to the detailed CBA analysis for the above options, it is recommended to implement adaptation options in the present day that will facilitate flexible adaptation in the future such as land use planning instruments. Any new assets should avoid the hazard zone. Coastal monitoring is required to regularly document changes to the shoreline to enable better prediction of management trigger timeframes. Further detail on recommendations are provided in the implementation plan (Chapter 7).



6 ASSESSMENT OF RISK TREATMENT OPTIONS

An Assessment of Risk Treatment Options Chapter Report (Appendix F) 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 to further 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 defensible. The CBA has addressed valuing the loss of assets, 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 to compare options with time-variable costs and benefits. It allows for the adjustment of 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 essentially 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 from previous MCA, and considered suitable for CBA, were:

- Planned/Managed Retreat – Voluntary acquisition of residential, commercial, public, tourism and environmental areas over various timeframes per MU as identified by the hazard mapping.
- Protect – Beach nourishment: placement of sand along the whole length of the relevant MU.
- Protect – Groynes: Only relevant for MU2 with three rock groynes on the beach, including initial beach nourishment.

The remaining adaptation options from WAPC (2019) are not considered suitable for CBA and have been costed using traditional budgeting techniques for MUs where they received a positive MCA score.



6.2 Results

The CBA has been used as an additional tool to assist decision-making when assessing adaptation options with which to proceed. However, 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.

All three MUs have resulted in PR1 Beach Nourishment having a positive benefit/cost ratio, and/or outperforming the other analysed options. For MU1 implementation was allowed for in 2052, for MU2 in 2022 and MU3 in 2037. On-ground works are required now for MU2 as the analysis shows that the existing dune buffer is insufficient to provide protection from a severe storm event.

A key assumption for the PR1 Beach Nourishment option is that a suitable sand source is available (grain size, volume, cleanliness and proximity). Further investigations are required to confirm the assumptions used in the analysis to develop a more accurate scope for the recommended options.

For all three Management Units the year of implementation has allowed for protection of some foreshore reserve as well as development further inland. 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 of protection options could be considered earlier. Alternatively if these areas were considered less important to this study area implementation could be delayed until more landward assets become unacceptably vulnerable. The existing estimate on the timeframe for implementation show that there is time to consider these competing priorities in more detail following further investigations to develop the options. Filling of any existing data and/or knowledge gaps (e.g. suitable sand source) is considered critical in confirming the recommended options before processing with implementation. Likewise, the enforcement of 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 either confirm or change the recommended option before its recommended implementation timeframe.



7 IMPLEMENTATION

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

7.1 Implementation Strategy

It is recommended the Shire execute a staged implementation strategy to incorporate the CHRMAP's strategic recommendations into its operations as outlined in Table 7-1.

Table 7-1 CHRMAP implementation strategy.

Milestone	Adaptation Actions	Adaptation Hierarchy
Present	Continue to accommodate development under the current planning framework with conditions requiring removal or relocation of the development once the Horizontal Shoreline Datum (HSD) is within the relevant S1 ¹ distance of the most seaward point of the development, in accordance with the CHRMAP Guidelines.	Planned/ Managed Retreat; Accommodate
CHRMAP Endorsement	Continue to accommodate development under the current planning framework with conditions requiring removal or relocation of the development once the HSD is within the S1 distance ¹ of the most seaward point of the development. The Shire shall update the online mapping tool to include the relevant data from the CHRMAP, including the HSD and S1 values for locations subject to erosion.	Planned/ Managed Retreat; Accommodate
Scheme Amendment / LPP Endorsement	Assess development against the amended planning framework which supports the adaptation hierarchy under the CHRMAP Guidelines, specifically: <ul style="list-style-type: none"> Prohibit subdivision or rezoning of land which has been identified as being subject to erosion over the 100-year planning timeframe; Prohibit development within the S1 distance of the HSD; Accommodate development not identified as being impacted by erosion in the short-term (S1) with conditions for the managed retreat of the development once the most seaward point of the development is within the short-term erosion zone (HSD plus S1 erosion). 	Avoid; Planned/ Managed Retreat; Accommodate
Protection Measures Implemented	Accommodate (time-limited) development where protection measures have been undertaken in accordance with the CHRMAP and/or any other relevant assessment endorsed by a suitably qualified coastal engineer.	Accommodate; Protect

¹ S1 is the erosion distance from acute storm erosion from a 100-year ARI storm event. This is seen as the present-day erosion risk and varies along the beach. Details and distances are presented in (Appendix C) Risk Identification (12 March 2024).



7.2 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, the policy instruments that govern development are an important tool to use in reducing risk exposure.

The following state and local measures are recommended:

- **Reservation of Land** to prevent intensification or inappropriate land use in areas exposed to coastal hazard. This is a suitable planning instrument to implement across the CHRMAP area.
- Establishment of **Special Control Area/s** (SCA) as an overlay to further regulate development in high exposure areas. A SCA should be applied to relate specifically to land subject to coastal processes (as recommended in WAPC, 2019) and is suitable across the CHRMAP area.
- A **Local Planning Policy** (LPP) can be prepared in respect of any matter related to the planning and development of the Scheme area. An SCA and LPP complement each other in providing appropriate provisions, and the LPP would further identify Council's intention to require notifications on Certificates of Title as a condition of the development approval. An LPP responsive to coastal hazard management is also suitable across the CHRMAP area.
- Inclusion of coastal hazard information for buyers through **Notifications on Titles** to increase awareness of hazard exposure and risk. A Notification on the Certificate of Title planning instrument is suitable across the CHRMAP area.
- Establishment of a program for **Compulsory Acquisition** of land under the *Land Administration Act 1997* where coastal hazard risk is deemed intolerable for habitation. This instrument should be carefully considered as reserve funds would need to be set aside by the Shire (through rates and levies). Where land remains zoned and within an SCA overlay this instrument may also be unexpected from the perspective of the community.
- Inclusion of coastal hazard exposure to be considered in **Structure planning**. There may be some areas within the CHRMAP area that will be subject to a structure plan in the future. This instrument would be suitable in that case.
- **Other instruments** such as leaseback arrangements and land swaps, which are presently conceptual however may become feasible as further investigation is completed over time.

No provisions exist currently (2024) within the Shire's local planning instruments to respond directly to broader coastal hazard challenges. There is an identified need to establish a response within the town planning legislative framework to manage the risks to an acceptable or tolerable level.

Any changes to the land use planning framework to reflect the identified risks would be undertaken after a detailed investigation into proposed coastal protection measures, as the specific coastal protection measure may alter the land use instrument required.

The Shire should prepare an amendment to Local Planning Scheme No. 6 to include provisions relating to the coastal erosion hazard zone.

7.3 Funding options

There exist revenue-raising mechanisms available for obtaining funds to assist implementation. Funding mechanisms that should be considered 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.

A detailed Benefit Distribution Analysis is recommended to inform a beneficiary-pays scheme for protection options such as beach nourishment.

7.4 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 whole planning timeframe to inform ongoing implementation and to increase the knowledge base for subsequent CHRMAP revisions and targeted investigations.

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

1. Routine beach and dune surveys, in the form of beach profiles, are recommended every six months, following the summer and winter seasons, 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 trigger points monitoring and/or to support specific project requirements. The beach survey may also be continuous along the coast using LiDAR (or other appropriate technique) 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 date, 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 – particularly for inundation events as it is often impractical to organise detailed survey at short notice.
3. Regular monitoring of existing coastal management structures and maritime facilities (e.g. Hopetoun Maritime Facility, access paths). These should be undertaken with consistent methodology to allow comparison between inspections. These can be commenced immediately, and the initial assessment would identify an appropriate review schedule for each structure, or if there is an issue with an asset. Monitoring would then be incorporated into the existing LGA and DoT asset management reporting systems.

Additionally, the ongoing state and federal monitoring should continue such as the

- Shoreline vegetation movement analysis from aerial photos undertaken by DoT,
- Water level monitoring undertaken by DoT,
- Wave data collection by DoT and the Shire: localised wave data collection is recommended for detailed design stages for protection options to supplement the existing wave buoy data from Bremer and Esperance,
- Bathymetric survey of entire study area to minimum 10m depth by DoT to include the nearshore reefs, and



- Wind recording by BOM.

7.4.1 Trigger Points

Ongoing monitoring shall be used to inform when certain triggers are close to being exceeded. The CHRMAP consider four types of trigger points, as follows:

- Proximity trigger: Where the most landward part of the Horizontal Shoreline Datum (HSD) is within the Storm Erosion Allowance (S1)² of the most seaward point of a public asset of interest or private property lot boundary. Due to the high value of the foreshore reserve, the foreshore reserve may be considered to be “the most seaward point”. 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 the lot 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, that is damaged by a coastal hazard shall require LGA approval before being repaired. The review process should involve 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.

This list follows a sequential / prioritisation order. That is, a “proximity trigger” is recommended over a “damage trigger”.

7.4.2 CHRMAP Review

This CHRMAP should be updated at least every 10 years to maintain currency and should be a “living document”. An earlier review should be considered when the following occur:

- Substantial storm events generating severe coastal hazards approaching or exceeding the CHRMAP projections.
- Significant changes to land-use planning – such as complex amendments to a Local Planning Scheme or the full review of the Planning Scheme.
- New information becomes available which substantially affects the summary of local community values and assets (natural or built). This may typically occur when consulting the community regarding other documents such as the Local Planning Scheme or Foreshore Management Plan, or the occurrence of a significant storm event.
- New information becomes available (filling of existing data gaps) that has the potential to alter the recommended protection measure from the CHRMAP. For example, should further investigations show that no economically viable local sand source is available, alternative recommendations other than beach nourishment might be required.
- Hazard modelling for the study area is updated given any of the following:
 - recent data collection,

² S1 is the erosion distance from acute storm erosion from a 100-year ARI storm event. This is seen as the present-day erosion risk and varies along the beach. Details and distances are presented in (Appendix C) Risk Identification (12 March 2024).



- 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.
- Ongoing coastal management operations within the study area should consider the status of both short and long-term adaptation strategy progress, including assessment of the performance and review of any identified strategies.

7.5 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 aligned on “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 MCA and CBA have been key gateway decision points for selecting many 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 draw comparisons between several options.

The CHRMAP 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 prior to be implemented. The options should be optimised and modified following such additional investigations.

An example of this could be changes to Management Unit boundaries, to optimise option effectiveness and to reduce costs. It may also be practical to develop a staged implementation approach to some of these management actions to test their effectiveness and to refine design of subsequent stages. Some interim management options may also be progressed, such as the placement of dune fences and re-vegetation to reduce erosion rates and loss of windblown sand.

7.5.1 Further Investigations

Information gaps identified in the CHRMAP should be filled early. Some of these gaps can be closed by the collection of data. Other information gaps can be closed prior or 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 Asset Management Plans, which identify existing infrastructure and recreational facilities in the coastal erosion hazard zone and provides direction to:
 - a. Progressively relocate non-critical assets away from the coastal hazard zone once they reach the end of asset life or become too exposed to coastal hazards (Proximity Trigger). This may include vulnerable recreational car parks; recreational amenities such as barbeque/picnic/shade areas;



playground and other recreational equipment; and access structures such as ramps, stairs and paths and fences, 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. This may include public safety infrastructure.
2. Investigate opportunities for leaseback of land and land swaps in the context of planned and managed retreat. Seek legal advice regarding the basis of agreements with landholders and whether opt-ins can be time constrained.
3. Sand source feasibility study – All MU's have recommended options which require sand nourishment for erosion management. The availability of suitable sand for beach nourishment works is unfortunately 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 local sand supplies. This study should consider both land-based and marine sand sources as well as evaluate potential environmental impacts and approvals required. Cost estimates 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. If the recommendations change to protection options that require rock (e.g. groynes or seawall) a rock source feasibility study will also be required before confidently confirming this recommendation. An analysis of the availability of such rock suitable for marine works, with suitable density, quarry yields, close location and tolerable costs should be undertaken.
4. Foreshore Management Plans (FMPs) - Updated foreshore management plans for the study areas may increase the protective capacity of the natural dune system. Foreshore management plans 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 recommendations for closing excess beach access points, ensuring appropriately fenced and signed paths, signage for dune repair and clear signage for 4-wheel drive access and permissibility,
 - 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 and use suitable engagement methods such as infographics and FAQ's. The education strategy should also include appropriate on-ground signage and information for beach access, camping and 4-wheel driving, where applicable.
 - g. Monitor impacts of 4WD vehicles (where applicable) and general beach access on nesting habitats and migratory bird species in dune areas.
 - h. Determine the need for a bush fire management plan for the dune and coastal areas.
5. Community education – updated 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.
6. Updated dune, beach (topography) and bathymetry survey data is to be collected. Current data sets from 2018 have a significant gap between the beach surveys and the extent of the bathymetric survey, with the gap size varying from 30 to 100m. This data gap is located within the active beach zone where the majority



of sediment movement occurs. In addition, no survey data exists of the offshore reefs. As such, it is recommended to close this existing data gap to update sediment movement modelling rates and Sbeach modelling as part of the next CHRMAP review.

7. Consider the need to undertake Benefit Distribution Analysis (BDA) for protection options such as beach nourishment in order to implement beneficiary pays principle to enable cost recovery from those who benefit from the adaptation options.

7.6 Implementation Plan

Medium (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:

- Continuing to action the revised planning instruments implemented in the short-term.
- Exhausting the SPP2.6 hierarchy of actions, high value assets may be protected where sustainable impacts and funding are identified/prioritised.
- Providing temporary/interim hazard protection may also become more costly and a change in adaptation pathway could be required. For example, as sea level rise progresses, it is possible that options using sand or rock resources to protect assets near the coast may become economically unsustainable. Implementing planned managed retreat could become favourable in that case.

Long-term adaptation strategies/pathways have been recommended for each MU to mitigate coastal 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.

No assets are predicted to be affected by **coastal inundation** within the study area (Water Technology 2022a and 2022c) with the exception of the Hopetoun Marine Facility. The marine facility was constructed in 1983 to primarily benefit the local fishing industry, with the groyne constructed wide enough to permit vehicles to drive up to the jetty and turn around. Department of Transport (DOT) WA has coordinated several technical investigations to review local coastal conditions and provide costed options that could improve the operability of the boat launching ramp. Future management and maintenance of the Groyne should include monitoring triggers including once damage or ongoing inundation occurs to the asset. DoT is likely to determine ongoing maintenance and end of asset life actions as part of their asset management plan. Increased frequency of asset inundation in combination with ongoing erosion of the foreshore area, which could impact access to the asset, could require demolition, relocation or major maintenance of the asset in the long term.

There is one primary coastal management action for **mitigating erosion hazards** across all MU's in Hopetoun:

- **Protect (PR1 – Beach Renourishment):** Undertake works as necessary to prevent erosion to assets. This management action involves the placement of sand of the upper beach face and dunes (example shown in Figure 7-1) across the entire length of each MU (total approximately 4.6km) to re-establish the sandy beach and provide an erosion buffer to existing assets.
- If significant storm damage occurs or pre-emptive works are preferred larger scale works with additional foreshore vegetation rehabilitation could occur. If more frequent management works are undertaken the sandy beach could be rebuilt as required with small beach width amounts and volumes.



Figure 7-1 Beach nourishment underway at Sunshine Coast, QLD

Detailed implementation plans for all MU's is presented in Table 7-2. The plan is presented in order of timing, with short-term actions stated before medium to long-term actions.

The focus should be on implementing land use planning, undertake investigations and monitoring alongside relocating assets as they become exposed to erosion hazards. Most importantly, a sand sourcing study shall confirm the availability and rate of sand in the area to implement the recommended beach nourishment activities.



Table 7-2 Implementation Plan

Recommendation	Notes	Responsibility	Trigger	Cost (if known) and Funding	present day-2037	2037-2052	2052-2122
INVESTIGATION Sand Source Feasibility Study	<ul style="list-style-type: none"> Determine the capacity and cost of local sand supplies, including both land-based and marine sources for beach nourishment One investigation for all MU's is recommended, therefore the timing is selected in line with the MU that requires beach nourishment earliest. 	<ul style="list-style-type: none"> LGA 	<ul style="list-style-type: none"> Completed CHRMAP 	<ul style="list-style-type: none"> Operational Grants (CAP) \$150,000 	Across all MU's		
Protection Structure Audit (NR2)	<ul style="list-style-type: none"> Item cost to inspect coastal asset condition (marine facility), influence on sediment transport and remaining design life on all coastal management structures 	<ul style="list-style-type: none"> LGA 	<ul style="list-style-type: none"> Completed CHRMAP 	<ul style="list-style-type: none"> Operational \$ 100,000 	MU2		
INVESTIGATIONS	<ul style="list-style-type: none"> Asset Management Plans Foreshore Management Plans Benefit Distribution Analysis (BDA) (if beneficiary pays principle is implemented for the proposed beach nourishment works) 	<ul style="list-style-type: none"> LGA 	<ul style="list-style-type: none"> Completed CHRMAP 	<ul style="list-style-type: none"> Operational Grants (CMPAP) \$300,000 	Across all MU's		
Locating assets in areas that will not be vulnerable to coastal hazards (AV)	<ul style="list-style-type: none"> Item cost for investigations and management plans 	<ul style="list-style-type: none"> LGA 	<ul style="list-style-type: none"> Completed CHRMAP 	<ul style="list-style-type: none"> Operational Grants (CMPAP) \$100,000 for studies 	Across all MU's		
Notification on title (NR3)	<ul style="list-style-type: none"> Indicate to current and future landowners that an asset is likely to be affected by coastal erosion over the planning timeframe. Help current and future owners make informed decisions about level of risk. Item cost to administer and notify 	<ul style="list-style-type: none"> LGA Can seek support and assistance from DPLH, WALGA 	<ul style="list-style-type: none"> Completed CHRMAP 	<ul style="list-style-type: none"> Operational Grants \$80,000 	Across all MU's		
Prevention of further development (PMR3)	<ul style="list-style-type: none"> Item cost for investigations and management plans Investigate opportunities for leaseback of land and land swaps in the context of planned and managed retreat. Seek legal advice regarding the basis of agreements with landholders and whether opt-ins can be time constrained. 	<ul style="list-style-type: none"> LGA 	<ul style="list-style-type: none"> Completed CHRMAP 	<ul style="list-style-type: none"> Operational Grants \$50,000 	Across all MU's		
Monitoring (NR1)	<ul style="list-style-type: none"> Infrastructure and asset audit. Involves long term baseline monitoring and event-based monitoring following storm erosion events. Routine beach and dune surveys every 6 months and corresponding photos Regular monitoring of structures Maintaining ongoing State monitoring activities as outlined in section 4.1 Occasional survey to track inundation and erosion extent and levels 	<ul style="list-style-type: none"> LGA DoT & LGA BOM 	<ul style="list-style-type: none"> Completed CHRMAP Severe storm event(s) 	<ul style="list-style-type: none"> Operational Grants (CAP) \$20,000 annually 	Across all MU's	Across all MU's	Across all MU's
Special Control Area (SCA6) – Coastal Hazard Risk Area (LU1)	<ul style="list-style-type: none"> Item cost for administering action and drafting Prepare and adopt amendment to Local Planning Scheme - additional SCA6. 	<ul style="list-style-type: none"> LGA 	<ul style="list-style-type: none"> Completed CHRMAP 	<ul style="list-style-type: none"> Operational \$50,000 	Across all MU's	Across all MU's	Across all MU's



Recommendation	Notes	Responsibility	Trigger	Cost (if known) and Funding	present day-2037	2037-2052	2052-2122
Adopt a Coastal Hazard local Planning Policy (LPP) (LU2)	<ul style="list-style-type: none"> Item cost for administering action and drafting Prepare and adopt a Coastal Hazard Local Planning Policy in accordance with Schedule 2 of the <i>Planning and Development (Local Planning Schemes) Regulations 2015</i>. 	<ul style="list-style-type: none"> LGA 	<ul style="list-style-type: none"> Completed CHRMAP 	<ul style="list-style-type: none"> Operational Grants (CMPAP) \$50,000 	Across all MU's	Across all MU's	Across all MU's
Maintain Beach Access and Dune Revegetation	<ul style="list-style-type: none"> Maintain beach access paths (localised beach scraping if sharp erosion scarp present, maintenance of fencing etc.) Undertake dune revegetation and fencing works to capture windblown sand to reduce erosion rates. 	<ul style="list-style-type: none"> LGA 	<ul style="list-style-type: none"> Completed CHRMAP Monitoring 	<ul style="list-style-type: none"> Operational Grants (Coastwest) 	Across all MU's	Across all MU's	Across all MU's
Demolition / removal / relocation of asset from inside hazard area (PMR2)	<ul style="list-style-type: none"> Maintenance assumes ongoing allowance for foreshore reserve Removal / Relocation of assets as required 	<ul style="list-style-type: none"> LGA 	<ul style="list-style-type: none"> Monitoring: identification of assets where damage would be unacceptable 	<ul style="list-style-type: none"> Operational Grants 	Across all MU's	Across all MU's	Across all MU's
CHRMAP Review	<ul style="list-style-type: none"> Review every 10 years in line with section 7.4.2 	<ul style="list-style-type: none"> LGA 	<ul style="list-style-type: none"> Completed CHRMAP 	<ul style="list-style-type: none"> Operational Grants (CMPAP) 	Across all MU's	Across all MU's	Across all MU's
Recommended Short-, Medium- and Long-term pathway to address Erosion is Protection with Beach Nourishment (PR1)	<ul style="list-style-type: none"> Assumes suitable sand source available (grain size, volume, cleanliness, proximity). Present day implementation for MU2, 2037 for MU3 and 2052 for MU1. Ongoing maintenance nourishment campaigns will be required after the placement of capital works. 	<ul style="list-style-type: none"> LGA 	<ul style="list-style-type: none"> Monitoring Updated CHRMAP 	<ul style="list-style-type: none"> Approximate capital cost of \$8.2 M at NPV 4% for MU1 and MU2, \$11.8M for MU3 Annual maintenance estimate of approximately \$0.65M for MU1, \$0.2M for MU2 and \$0.5M for MU3 Operational Grants (CAP) Direct beneficiaries 	MU2	MU2, MU3	MU1, MU2, MU3





APPENDIX A ESTABLISH THE CONTEXT CHAPTER REPORT







APPENDIX B RISK IDENTIFICATION CHAPTER REPORT







APPENDIX C VULNERABILITY ANALYSIS CHAPTER REPORT







APPENDIX D RISK EVALUATION AND TREATMENT CHAPTER REPORT







APPENDIX E
ASSESSMENT OF RISK TREATMENT OPTIONS
CHAPTER REPORT







APPENDIX F IMPLEMENTATION AND MONITORING CHAPTER REPORT







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