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R2051 Draft D

May 2025

Smiths 2014 Pty Ltd

Smiths Beach Project
Coastal Hazard Risk Management & Adaptation Planning

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1. Introduction

Smiths 2014 Pty Ltd (the Proponent) is looking to create a vibrant coastal tourist node through the development of Lot 4131 Smiths Beach Road, Yallingup (the Site) and the associated foreshore. The Proponent has assembled a team of planners, architects, environmental consultants, civil engineers, geotechnical specialists and coastal engineers to help plan the development.

The proposed development will consist of:

- Tourist development comprising hotel accommodation, restaurant and wellness centre;
- Campground;
- Community Hub comprising café, reception hall, surf lifesaving club;
- Cape to Cape Welcome Centre and general store/bakery; and
- Holiday homes.

The site master plan developed by the Proponent and its team is presented in the figure below.

Figure 1.1 Smiths Beach Development – Site Master Plan

Given the coastal nature of the development, The Proponent engaged specialist coastal and port engineers M P Rogers & Associates Pty Ltd (MRA) to provide assistance with the coastal planning and management components of the development. This Coastal Hazard Risk Management & Adaption Plan (CHRMAP) has been prepared as a component of the overall Foreshore

Management Plan to outline the extent of coastal hazard risks related to the development and the proposed approach to the management of these risks over time. Importantly, this CHRMAP draws on and aligns with the outcomes from a broader CHRMAP completed by the City of Busselton (City) in 2022 for this area.

1.1 State Planning Policy 2.6

Within Western Australia, State Planning Policy 2.6: State Coastal Planning Policy (SPP2.6; WAPC 2013) provides guidance for land use and development decision-making within the coastal zone, including the establishment of coastal foreshore reserves to protect, conserve and enhance coastal values. SPP2.6 also provides guidance on the assessment and management of coastal hazard risks for assets located in close proximity to the coast.

The objectives of SPP2.6 are wide ranging; however, a key component of the policy is the identification of appropriate areas for the sustainable use of the coast. This includes use for recreational, tourism and commercial purposes.

Guidance on the assessment of coastal hazard risk and development of appropriate management and adaptation plans is provided within SPP2.6. In particular, the requirements for the preparation of a CHRMAP are outlined within SPP2.6 as well as the CHRMAP Guidelines (WAPC 2019).

The key requirement of a CHRMAP is to develop a risk based adaptation framework for assets that could be at risk of impact by coastal hazards over the relevant planning timeframes. Importantly, the balance of these risks needs to be considered with reference to the expected lifetime of the relevant assets.

2. Context

2.1 Purpose

The potential vulnerability of the coastline and the subsequent risk to the community, economy and environment needs to be considered for any coastal development.

SPP2.6 requires that the responsible management entity completes a CHRMAP where an existing or proposed development may be at risk from coastal hazards over the planning timeframe. The main purpose of the CHRMAP is to define areas of the coastline which could be vulnerable to coastal hazards and to outline the preferred approach to the monitoring and management of these hazards where required.

A CHRMAP can be a powerful planning tool to help provide clarity to existing and future developers, users, managers or custodians of the coastline. This is done by defining levels of risk exposure, management practices and adaptation techniques that the management authority considers acceptable in response to the present and future risks posed by coastal hazards.

Specifically, the purpose of this CHRMAP is as follows:

- Determine the specific extent of coastal hazards in relation to the proposed development of the Site.
- Determine the coastal hazard risks and vulnerability, and, how these risks may change over time.
- Establish the basis for present and future risk management and adaptation, with specific reference to the management approaches outlined within the City's CHRMAP.
- Provide guidance on appropriate management and adaptation planning for the future.

2.2 Objectives

The key objectives of this CHRMAP are as follows:

- Inform the development of the Site by providing appropriate guidance to the Proponent, City and other key stakeholders with respect to the management of coastal hazards.
- Ensure that the proposed future management approaches align with the City's own management approach, as outlined within the City's CHRAMP.
- Outline the required coastal adaptation approach in an implementation plan that is acceptable to the Proponent, the City and key stakeholders.

2.3 Scope

The CHRMAP Guidelines provide a specific framework for the preparation of a CHRMAP. This is outlined in the flowchart presented in Figure 2.1 which shows the risk management process adapted to coastal planning.

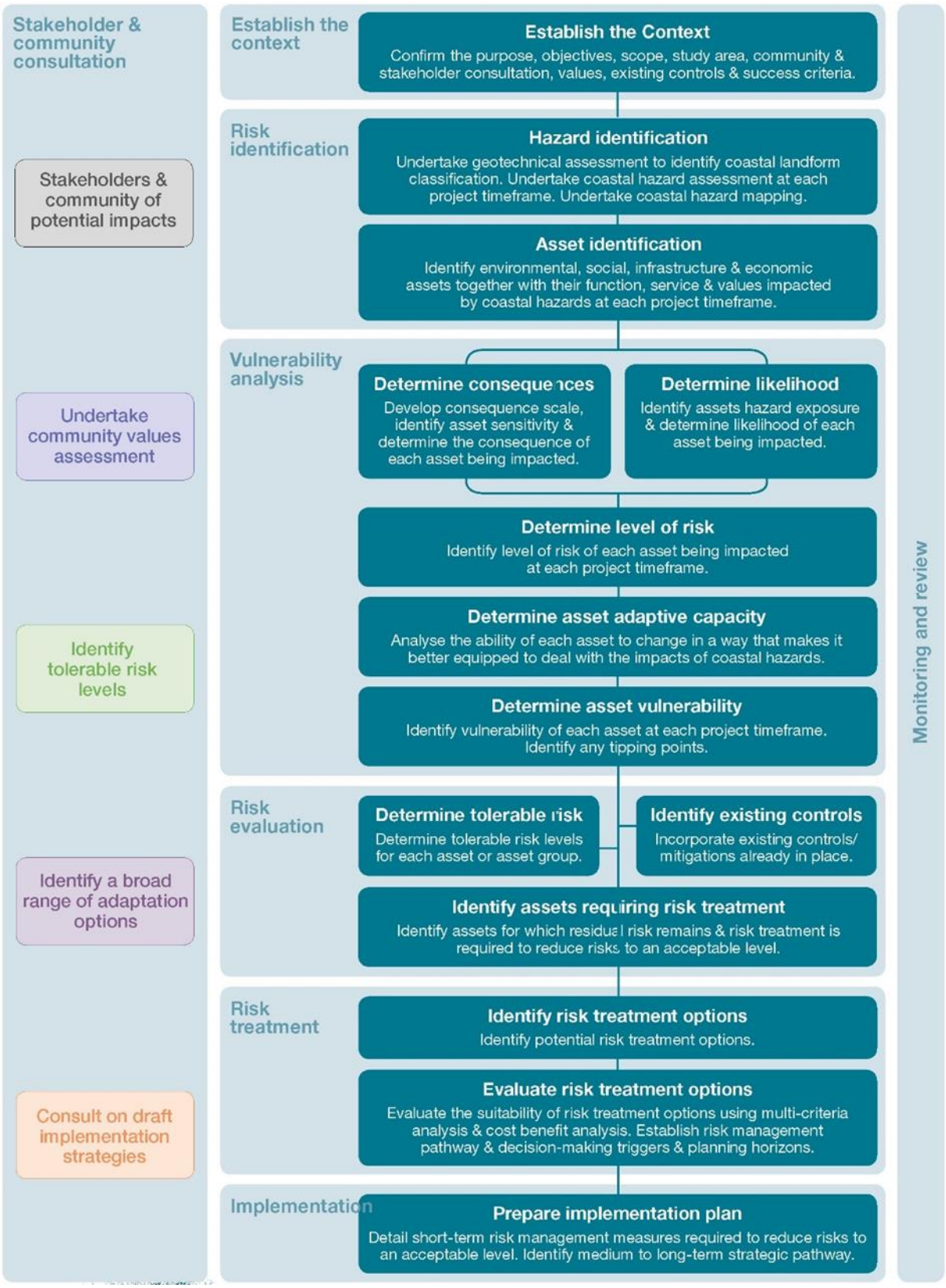

Figure 2.1 Risk Management & Adaptation Process Flow Chart (WAPC 2019)

As presented in the flowchart, the process for the development of a meaningful CHRMAP process requires a number of fundamental inputs. These inputs enable the assessment and analysis of

risk, which should ultimately be informed by input received from key stakeholders, to help shape the subsequent adaptation strategies.

The development of the Site will require an adaptation plan that is acceptable to all stakeholders. As a result, the approach that has been taken for this plan is to develop a management methodology that closely aligns with the management approach outlined in the City's CHRMAP.

The development of the adaptation plan will be informed by the assessment of the coastal erosion and inundation hazards at the site.

This CHRMAP will consider the potential risks posed by coastal hazards over a range of horizons. The coastal hazards over a 100 year timeframe are required for consideration under SPP2.6. The following coastal hazard timeframes are therefore examined in this assessment.

- 2043.
- 2073.
- 2123.

Based on the results of the risk assessment, risk mitigation strategies will be developed, where required, to provide a framework for future management. However, it is important to realise that the risk assessment will be based on the outcomes of the coastal hazard assessment, which, by their nature, are justifiably conservative. This is due to the uncertainty around coastal dynamics when predicting impacts over long timeframes. As a result, the framework for future risk management strategies should be a guide of future requirements. The actual requirement for implementation of these management actions should ultimately be informed by a coastal monitoring regime.

The purpose of the coastal monitoring regime is to identify changes in the shoreline or sea level that could alter, either positively or negatively, the risk exposure of the proposed assets and infrastructure.

2.4 The Site

Smiths Beach is located near the town of Yallingup on the South West coast of Western Australia. The beach is very popular amongst tourists and locals. It is used for swimming, fishing, surfing, exercising and general recreation. The location of the Site, Lot 4131, is shown in the figure below.

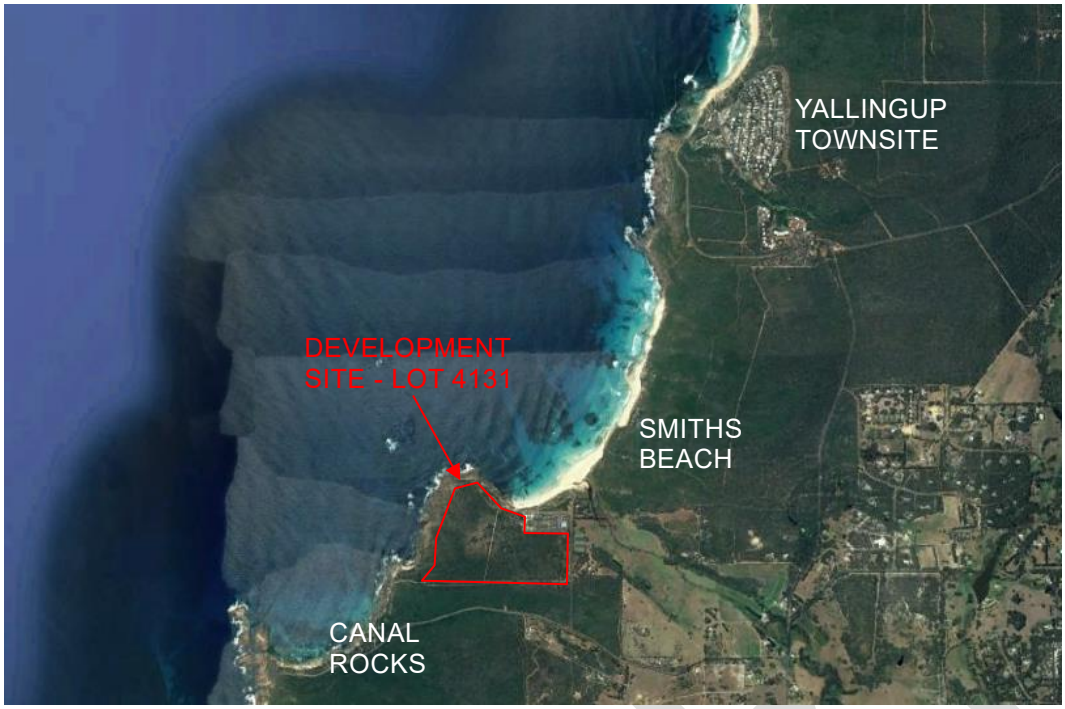

Figure 2.2 Site Location

Smiths Beach comprises sandy beaches to the east and a rocky coast and headland to the west. The rocky coast offers much of the site natural protection from erosion.

Figure 2.3 Smiths Beach Looking East

2.5 Foreshore Development Planning

The proposed Foreshore Management Responsibility Plan prepared by Taylor Burrell Barnett and included with the Foreshore Management Plan (FMP) is shown in Figure 2.4.

The City of Busselton are considered the appropriate authority to take on management responsibility of the proposed Foreshore Reserve. This is consistent with discussions between the City and DPLH to finalise management orders for the adjacent dune area in front of Smiths Beach Resort and Canal Rocks Apartments.

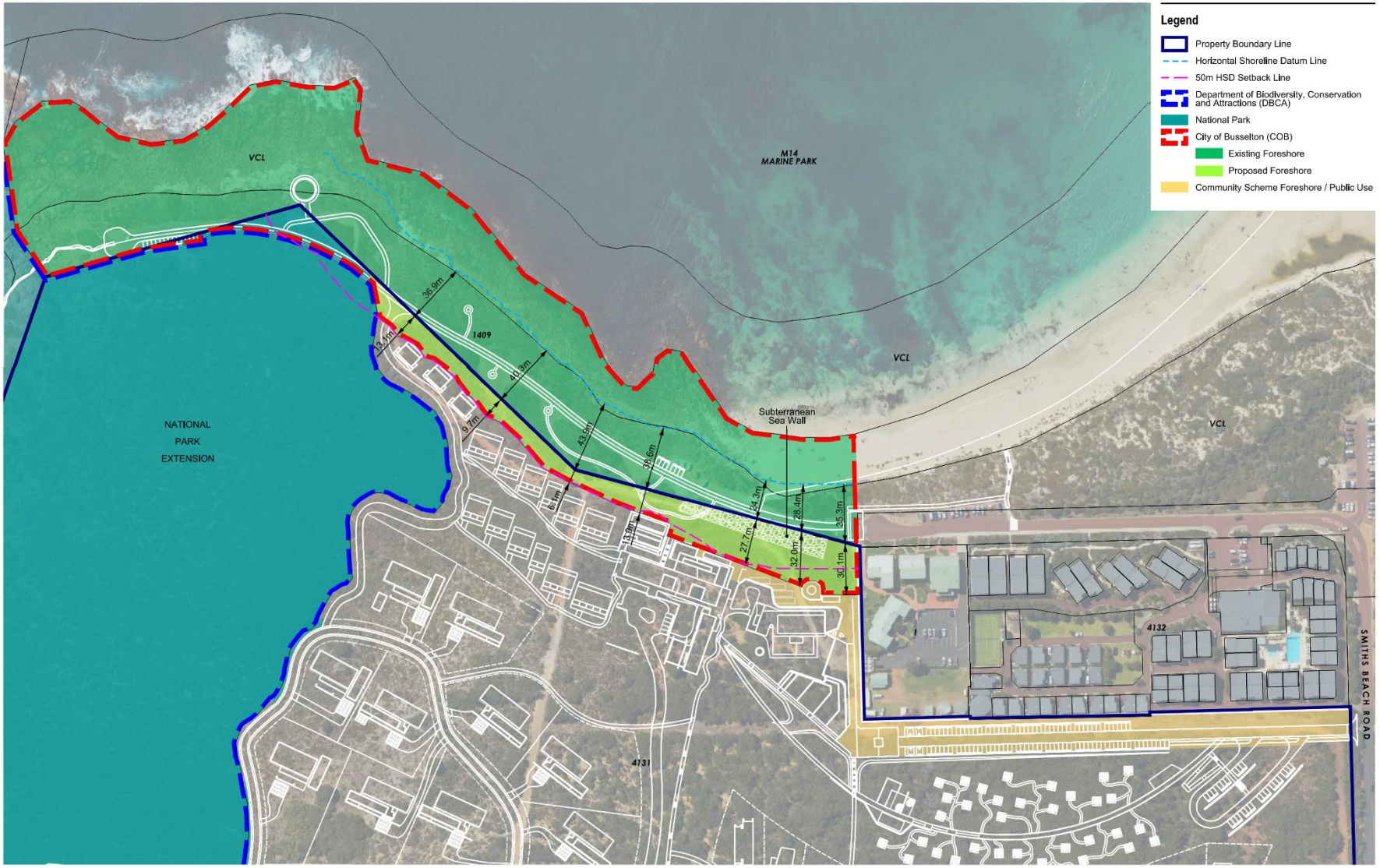

Figure 2.4 Foreshore Management Responsibility

The proposed Foreshore Reserve extends 50 m to 70 m inland from the horizontal shoreline datum (HSD). This is visually represented by the green and light green shaded areas in Figure 2.4.

The Proponent has carefully considered the full range of uses for the foreshore area and prepared the proposed Foreshore Reserve Plan presented in Figure 2.5. A foreshore illustration is presented in Figure 2.6.

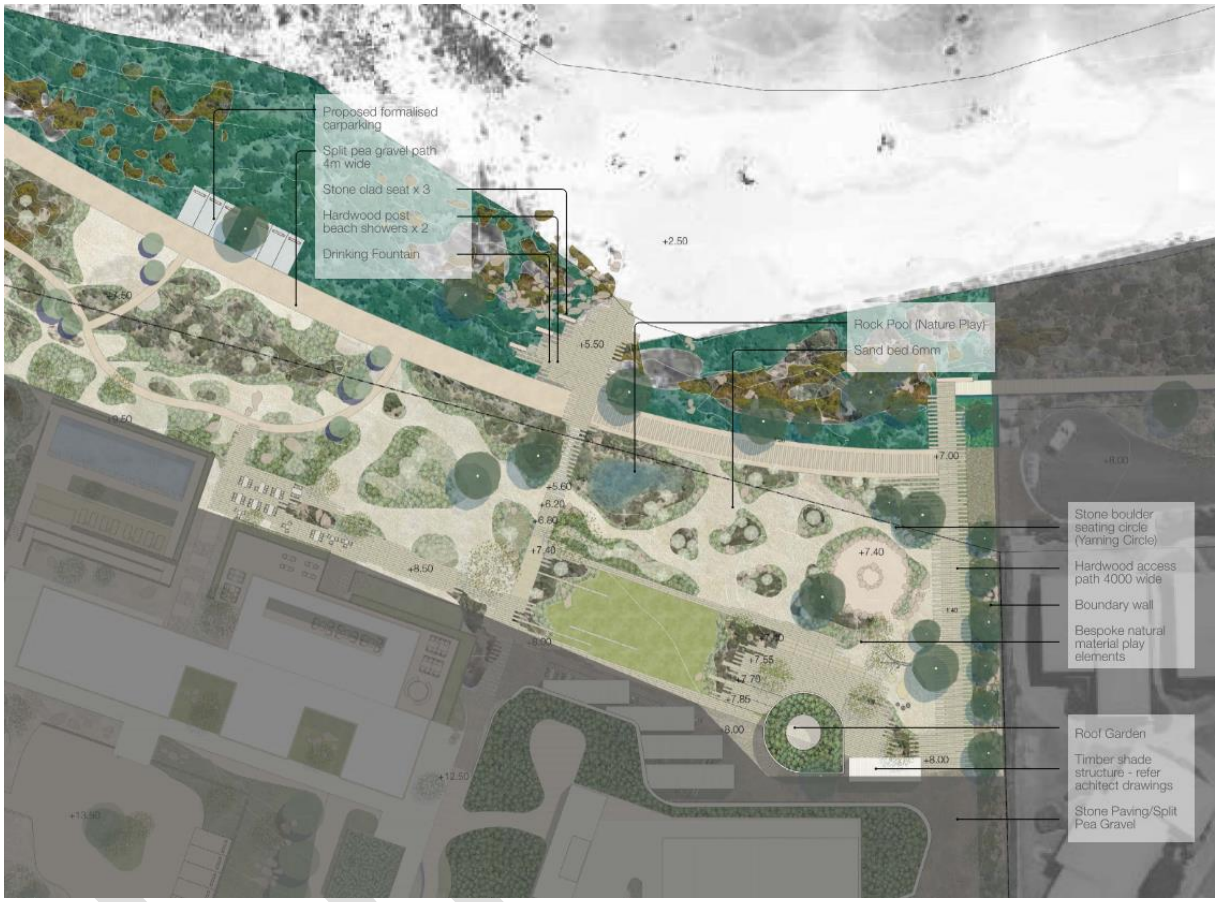

Figure 2.5 Foreshore Detail Plan

Figure 2.6 Foreshore Illustration

2.6 City of Busselton CHRMAP

As part of this assessment MRA reviewed the City's CHRMAP and the technical documents that were used to support its preparation. The technical documents reviewed include the Cape Naturaliste Settlements Coastal Vulnerability Assessment (Damara, 2017) and the Coastal Adaptation Strategy (Advisian, 2020).

2.6.1 Coastal Erosion Hazards

The technical work completed to inform the CHRMAP needed to cover the entire coastline managed by the City and consequently it was impractical to conduct site specific geotechnical investigations to explore the possibility of underlying rock beneath the dunes. As a result, the coastal hazard recommendations have been presented on the assumption that no underlying rock is present beneath the dunes at Smiths Beach.

The City's CHRMAP recommended more detailed work on rock investigations and coastal modelling be completed for the Smiths Beach management unit. This more detailed work has been completed and is presented in MRA (2021).

Golder Associates completed a comprehensive geotechnical investigation around the Site and the drilling confirmed the presence of high strength rock in many places. The presence of this rock greatly reduces the risk of coastal erosion and therefore the erosion risks stated in the City's CHRMAP are likely to overrepresent the potential extent of the coastal hazard impact.

2.6.2 Coastal Hazard Management Options

SPP2.6 states that coastal hazard adaption measures should be sought from the following coastal hazard risk management and adaption planning hierarchy on a sequential and preferential basis.

- Avoid
- Planned or Managed Retreat
- Accommodation
- Protection

The City completed a Multi-Criteria Analysis (MCA) for each management unit by assessing each adaption measure against an acceptability criteria, feasibility criteria and financial criteria. The outcome of the MCA concluded that a protection option is the most appropriate for Smiths Beach. Significantly, protection is noted in the CHRMAP as a requirement across all timeframes, including "current – 2043", "2043 – 2073" and "2073 – 2123".

For the "current – 2043" timeframe, the City's CHRMAP proposes the following coastal management response:

> *"1. To protect the beach, beach amenity, fore dune, infrastructure and buildings, maintain existing fore dune and beach as much as possible, and install coastal protection structures, such as seawalls or groynes, as necessary.*
>
> *2. Supplement the infrastructure described above with beach nourishment."*

Consistent commentary is provided throughout the described actions for the other planning horizons, with the stated intention being to construct a seawall to protect existing infrastructure and the Site.

2.7 Success Criteria

The success criteria for the CHRMAP will ultimately be as follows:

- Demonstrated understanding by the key stakeholders regarding the likelihood, consequence and subsequent risk of coastal hazards impacting identified assets over each planning horizon.
- Acceptance of a risk management and adaptation plan for the 100 year planning timeframe by key stakeholders.
- Adoption of the Implementation Plan by key stakeholders.

The outcomes of the success criteria listed above are presented in later sections of this report.

3. Coastal Hazard Assessment

An understanding of the coastal hazards and subsequent risks is critical for the determination of management and adaptation actions. The potential extent of coastal erosion hazard impact on the coastline fronting the development was shown with the City's CHRMAP. The potential extent of coastal erosion impacts is indicated by the coastal erosion hazard lines presented in Figure 3.1.

Figure 3.1 Coastal Erosion Hazard Lines (City 2022)

These coastal erosion hazard lines were prepared to indicate that the potential extent of coastal erosion impact over the various planning horizons. It must be understood that these coastal hazard lines are not predictions of future shoreline location, but rather are the outcome of risk based assessments that provide an indication of the potential future extent of erosion over these respective timeframes. Furthermore, it should be noted that geotechnical assessment (as outlined in MRA (2021)) for the area around the proposed development of the Site identified competent hard rock in the area. This means that these coastal hazard lines are expected to include a higher level of conservatism than normal. Nevertheless, the coastal hazard lines are considered acceptable for the purposes of this CHRMAP process.

Assessment of potential coastal inundation hazards was also completed within the City's CHRMAP. This shows that the Site is well above the potential inundation levels and therefore there is no risk posed from coastal inundation.

3.1 Key Assets

The location of the coastal hazard lines enables the identification of assets that need to be considered further within the CHRMAP. The identified assets are outlined below and are identified in Figure 3.2.

- Smiths Beach Road (including Parking).
- Foreshore Area.

- Canal Rocks Beachfront Apartments.
- Smiths Beach Resort.
- Proposed Development Area.

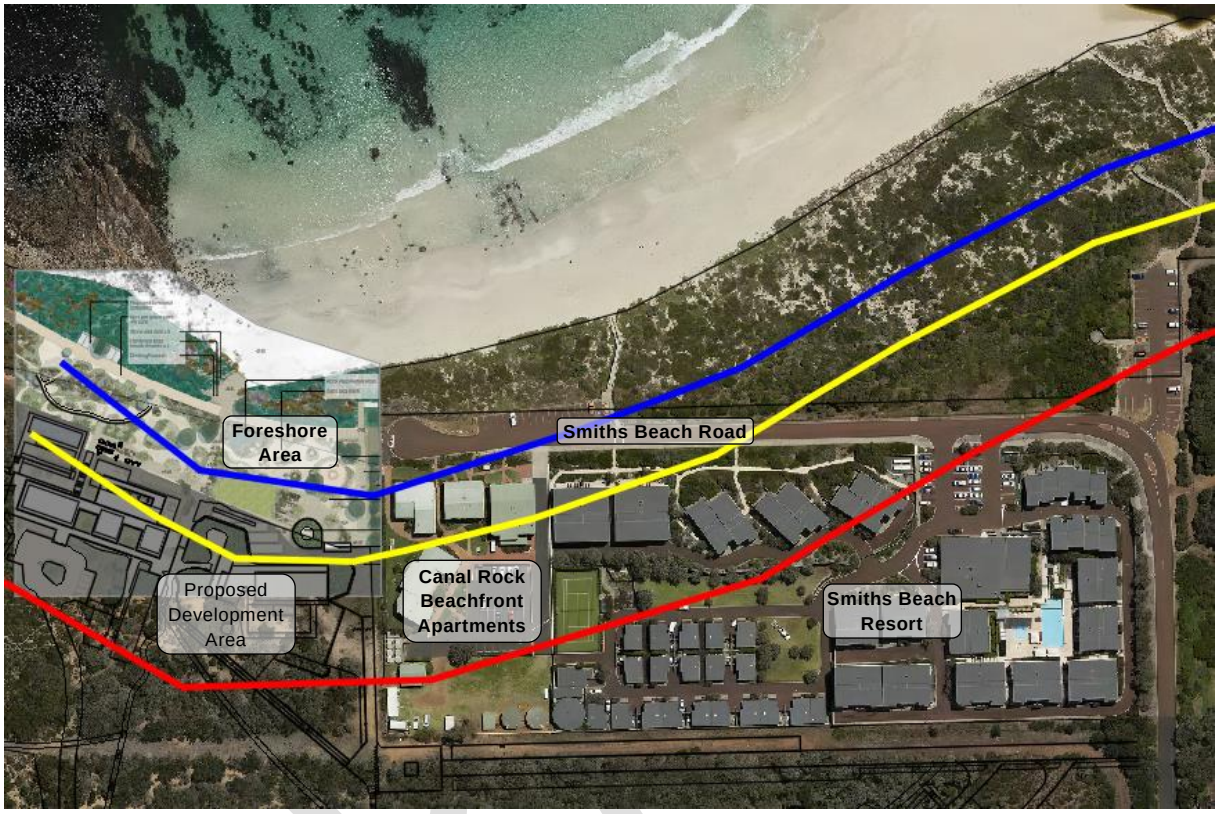

Figure 3.2 Key Assets to be Considered in the CHRMAP

4. Risk Analysis

In accordance with the CHRMAP Guidelines, a risk based approach is used to assess the hazards and required mitigation and adaptation options for the key assets identified above. As coastal hazards are the focus of this assessment, it is the likelihood and consequences of these coastal hazards that need to be considered.

4.1 Likelihood

Likelihood is defined as the chance of something happening (AS/NZS ISO 31000:2009). The CHRMAP Guidelines define the likelihood as the chance of erosion or storm surge inundation occurring or how often they impact on existing and future assets and values. This requires consideration of the frequency and probability of the event occurring over a given planning timeframe.

The probability of an event occurring is often related to the Average Exceedance Probability (AEP) or the ARI. The use of the AEP to define impacts of coastal hazards over the planning timeframe assumes that events have the same probability of occurring each year. In the case of climate change and sea level rise, which has a large influence on the assessed coastal hazard risk, this is not true. In addition, there is insufficient data available to properly quantify the probability of occurrence. A scale of likelihood has therefore been developed.

The scale of likelihood follows the Australian Standard Risk Management Principles and Guidelines (AS/NZS ISO 31000:2009). This is presented in Table 4.1.

Table 4.1 Scale of Likelihood

Rating	Description/Frequency
Almost certain	There is a high possibility the event will occur as there is a history of frequent occurrence. 90 – 100% probability of occurring over the timeframe.
Likely	It is likely the event will occur as there is a history of casual occurrence. 60 – 90% probability of occurring over the timeframe.
Possible	The event may occur. 40 – 60% probability of occurring over the timeframe.
Unlikely	There is a low possibility that the event will occur. 10 – 40% probability of occurring over the timeframe.
Rare	It is highly unlikely that the event will occur, except in extreme/exceptional circumstances. 0 – 10% probability of occurring over the timeframe.

The likelihood and consequences of coastal hazards are different for erosion and inundation. As such, the likelihood and consequence for erosion and inundation have been considered separately.

An assessment of the relative likelihood of each of the identified key assets being impacted by coastal erosion hazards has been completed and is presented in Table 4.2.

It is important to note that the hazard lines reaching a particular asset at the end of the planning timeframe do not necessarily mean this will occur. This is because it requires all of the following to occur.

- A reduction in the rate of shoreline accretion into the future.
- The upper limit of shoreline recession caused by sea level rise.
- The 100 year ARI severe storm event to be experienced at the end of the planning timeframe (ie when the other allowances have been lost).
- Loss of the factor of safety and allowance for uncertainty.

Only if all of these occur will the coastal erosion hazard lines be realised. This has been considered in the assessment of likelihood. The erosion likelihood for various assets are presented in the following table.

Table 4.2 Coastal Erosion Likelihood

Key Asset	2043	2073	2123
Smiths Beach Road (including Parking)	Unlikely	Possible	Almost Certain
Foreshore	Likely	Almost Certain	Almost Certain
Canal Rocks Beachfront Apartments	Rare	Unlikely	Almost Certain
Smiths Beach Resort	Rare	Unlikely	Almost Certain
Proposed Development Area	Rare	Unlikely	Almost Certain

4.2 Consequence

Consequence is the impact of erosion and storm surge inundation on existing and future assets and the value assigned to that asset (WAPC 2019). Within the context of the vulnerability assessment, consequence is used to consider the sensitivity of an asset to coastal erosion and inundation hazards over the 100 year planning timeframe.

A scale of consequence has been adopted for this assessment. It provides a range of impacts and is generally consistent with the Australian Standard Risk Management Principles and Guidelines (ISO 31000:2009) and CHRMAP Guidelines. The consequence scale is presented in Table 4.3.

Table 4.3 Scale of Consequences

	Category		
Level	**Social & Heritage**	**Economic**	**Environment**
Catastrophic	Loss of vital social or heritage values, experiences and/or sites of both local and regional significance. No alternative exists.	Damage to local economy, public or private infrastructure or loss of land value greater than $25 million.	Irreversible damage to local environmental asset(s) that would compromise its viability. No alternate habitat(s) exist.
Major	Loss of important social or heritage values, experiences and/or sites that would impair quality of life of the local community. No convenient alternative exists.	Damage to local economy, public or private infrastructure or loss of land value $5 million to $25 million.	Major damage to local environmental asset(s) that would compromise its viability. No alternate habitat exists.
Moderate	Loss of social or heritage values, experiences and/or sites that would somewhat impair quality of life of the local community. No convenient alternative exists.	Damage to local economy, public or private infrastructure or loss of land value $500,000 to $5 million.	Moderate damage to local environmental asset that could be reversed or offset. Local alternate habitats exist.
Minor	Loss of social or heritage values, experiences and/or sites that would have minimal impact on the quality of life of the local community. Alternative sites exist.	Damage to local economy, public or private infrastructure or loss of land value $100,000 to $500,000.	Minor environmental damage to local environmental asset(s) that could be reversed or offset. Local or regional alternate habitat exists.
Insignificant	Loss of social or heritage values, experiences and/or sites that would have little to no impact on quality of life of the local community. Many alternatives exist.	Damage to local economy, public or private infrastructure or loss of land value less than $100,000.	Insignificant damage to local environmental asset(s); recovery may take less than six months.

The consequences of coastal erosion for the proposed redevelopment are presented in the following table.

Table 4.4 Coastal Erosion Consequence

Key Asset	2043	2073	2123
Smiths Beach Road (including Parking)	Moderate	Moderate	Moderate
Foreshore	Minor	Minor	Minor
Canal Rocks Beachfront Apartments	Minor	Moderate	Major
Smiths Beach Resort	Insignificant	Moderate	Major
Proposed Development Area	Insignificant	Moderate	Major

Table 4.4 indicates the following.

- The loss of Smiths Beach Road has been assessed as Moderate due largely to the social impacts associated with the loss of the road.
- The loss of the foreshore has been assessed as minor due to the monetary cost of infrastructure replacement in the foreshore.
- The consequence of impacts to Canal Rocks Beachfront Apartments will increase over time as more of the site would become impacted. The consequence starts off as minor due to the small potential impact, but increases to moderate and major in 2073 and 2123 respectively as increasing proportions of the site are impacted.
- The impact to the Smiths Beach Resort is rated as insignificant to 2043 as the resort avoids the coastal erosion hazard, however the cost impact of further loss is expected to increase to moderate and major in 2073 and 2123 respectively.
- The assessment for the proposed development follows a similar rationale to that for the Smiths Beach Resort.

5. Level of Risk

5.1 Risk Level Matrix

The risk rating from a risk assessment is defined as “likelihood” x “consequence.” A risk matrix defining the levels of risk from combinations of likelihood and consequence has therefore been developed for the coastal hazards. This risk matrix is generally consistent with the CHRMAP Guidelines.

Table 5.1 Risk Level Matrix

RISK LEVELS		CONSEQUENCE				
		Insignificant	Minor	Moderate	Major	Catastrophic
LIKELIHOOD	Almost Certain	Low	Medium	High	Extreme	Extreme
	Likely	Low	Medium	Medium	High	Extreme
	Possible	Low	Medium	Medium	Medium	High
	Unlikely	Low	Low	Medium	Medium	Medium
	Rare	Low	Low	Low	Low	Medium

A risk tolerance scale assists in determining which risks are acceptable, tolerable and unacceptable. The risk tolerance scale used for the assessment is presented in Table 5.2. The risk tolerance scale shows that the extreme and high risks need to be managed.

Table 5.2 Risk Tolerance Scale

Risk Level	Action Required	Tolerance
Extreme	Immediate action required to eliminate or reduce the risk to acceptable levels	Intolerable
High	Immediate to short term action required to eliminate or reduce risk to acceptable levels	Intolerable
Medium	Reduce the risk or accept the risk provided residual risk level is understood	Tolerable
Low	Accept the risk	Acceptable

5.2 Risk Assessment

The results of the risk assessment are presented in Table 5.3.

Table 5.3 Assessment of Risk of Coastal Erosion Impact

Key Asset	2043	2073	2123
Smiths Beach Road (including Parking)	Medium	Medium	High
Foreshore	Medium	Medium	Medium
Canal Rocks Beachfront Apartments	Low	Medium	Extreme
Smiths Beach Resort	Low	Medium	Extreme
Proposed Development Area	Low	Medium	Extreme

Table 5.3 shows that no assets have an intolerable risk of impact to 2043, however a medium level of risk exists for Smiths Beach Road and the foreshore over this timeframe. Thereafter the risk for all assets would be medium by 2073.

By 2123 the risk to the Canal Rocks Beachfront Apartments, Smiths Beach Resort and the Proposed Development Area would be extreme. The risk to Smiths Beach Road would be high, noting that both extreme and high risks are intolerable, this would mean that management actions would be required by this time.

6. Vulnerability

As per the recommendations of AS 5334 Climate change adaptation for settlements and infrastructure, a detailed risk analysis should include a vulnerability analysis to thoroughly examine how coastal hazards and climate change may affect the assets. This includes consideration of the adaptive capacity and vulnerability of the assets previously assessed for coastal hazard risk.

The vulnerability of the identified assets are related to the risk from coastal hazards, as well as their sensitivity to the impacts caused by these hazards and their ability to respond to them (termed adaptive capacity). This is demonstrated in the CHRMAP Guidelines (WAPC 2019) by the following Figure 6.1.

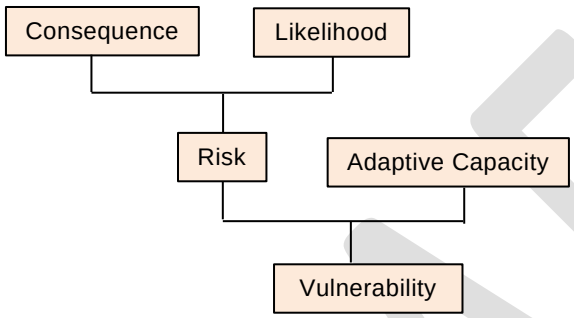

Figure 6.1 Vulnerability Assessment Flowchart (WAPC 2019)

6.1 Adaptive Capacity

Adaptive capacity is defined in AS5334 as the ability to respond to climate change to moderate potential damage, to take advantage of opportunities, or to cope with the consequences. For assets where the impact of the coastal hazard was insignificant or where the asset would be re-established naturally before further damage would likely occur, the adaptive capacity of the asset will be rated as insignificant impact or N/A.

The adaptive capacity should be considered in conjunction with any changes to the current risk factors over time which may influence an assets future vulnerability. A scale of adaptive capacity has been developed for this assessment and is presented in Table 6.1.

Table 6.1 Adaptive Capacity Ratings

Rating	Description / Frequency
Insignificant Impact; N/A	The impact of the coastal hazard on the asset would have an insignificant impact. This includes where the control or asset would be re-established naturally before further damage would likely occur.
Very High	Very high ability to absorb coastal hazard impacts or where capacity can be restored at relatively low cost. Capacity would be restored naturally over time.
High	Reasonable ability to absorb coastal hazard impacts, with functionality able to be restored . Natural restoration of capacity may occur slowly over time.
Moderate	Small amount of ability to absorb coastal hazard impacts. Restoration of functionality would be difficult, though possible.
Low	Little to no ability to absorb coastal hazard impacts. Functionality would be unable to be restored.

The adaptive capacity of each of the identified assets against coastal erosion impacts have been determined and are presented in Table 6.2.

Table 6.2 Coastal Erosion Adaptive Capacity Ratings

Key Asset	Adaptive Capacity
Smiths Beach Road (including Parking)	Low
Foreshore	Moderate
Canal Rocks Beachfront Apartments	Low
Smiths Beach Resort	Low
Proposed Development Area	Low

In some cases the adaptive capacity of the assets in response to coastal erosion is related to the availability of space for reinstating the assets or the ability for the asset to continue to function. Built form assets such as Smiths Beach Road, the Canal Rocks Beachfront Apartments, Smiths Beach Resort and the Proposed Development Area all have low adaptive capacities as they have no ability to be able to absorb coastal erosion impact. The foreshore area would have a moderate level of adaptive capacity as it would be able to be restored, to some degree, to continue to serve its function.

6.2 Vulnerability Assessment

The following matrix was developed for the assessment of the vulnerability of the key assets. The vulnerability of each identified asset is defined by the adaptive capacity and risk level, where a high adaptive capacity decreases the initial risk rating of an asset. The vulnerability matrix is shown in Table 6.3 below.

Table 6.3 Vulnerability Matrix

VULNERABILITY LEVELS		ADAPTIVE CAPACITY				
		Insignificant Impact; N/A	Very High	High	Moderate	Low
RISK LEVEL	Extreme	Low	Medium	High	Extreme	Extreme
	High	Low	Low	Medium	High	High
	Medium	Low	Low	Low	Medium	Medium
	Low	Low	Low	Low	Low	Low

A vulnerability tolerance scale is important to define the level at which adaptive capacity is deemed acceptable, tolerable or intolerable/unacceptable. The following tolerance scale has been adopted for this assessment.

Table 6.4 Vulnerability Tolerance Scale

Vulnerability Level	Further Action Required	Vulnerability Tolerance
Extreme	Asset has minimal capacity to cope with the impacts of coastal hazards without additional action. Adaptation needs to be considered as a priority.	Unacceptable / Intolerable
High	Asset has limited ability to cope with the impacts of coastal hazards. Adaptation should be considered to reduce vulnerability to acceptable levels.	Tolerable, if as low as possible
Medium	Asset has some ability to cope with the impacts of coastal hazards. Actions should be considered to reduce vulnerability as low as reasonably practical (ALARP).	Tolerable / Acceptable
Low	Assets has high resilience and is able to cope with the impacts of coastal hazards without additional action.	Acceptable

The vulnerability tolerance scale shows that assets with High and Extreme vulnerability need to be managed to reduce vulnerability levels to Medium or Low. Despite being considered acceptable, assets with Medium or Low vulnerabilities should also be considered for adaptation measures to reduce vulnerability levels as low as reasonably practical.

The vulnerabilities of each of the identified assets have been determined and are shown in Table 6.5. The assets identified as having High or Extreme vulnerability from coastal erosion impact are expected to require management over the respective planning horizons.

Table 6.5 Assessment of Vulnerability of Coastal Erosion Impact

Key Asset	2043	2073	2123
Smiths Beach Road (including Parking)	Medium	Medium	High
Foreshore	Medium	Medium	Medium
Canal Rocks Beachfront Apartments	Low	Medium	Extreme
Smiths Beach Resort	Low	Medium	Extreme
Proposed Development Area	Low	Medium	Extreme

7. Risk Adaptation & Mitigation Strategies

7.1 Available Risk Mitigation Strategies

Risk adaptation and mitigation strategies are required for the City to address the coastal hazard risks and asset vulnerabilities identified in Section 5. SPP2.6 outlines a hierarchy of risk adaptation and mitigation options, where options that allow for a wide range of future strategies are considered more favourably. This hierarchy of options is reproduced in Figure 6.1.

Figure 7.1 Risk Management & Adaptation Hierarchy

These four broad options are outlined below.

- Avoid – avoid placing new assets within the area impacted by coastal hazards.
- Retreat – the relocation or removal of assets within an area identified as likely to be subject to intolerable risk of damage from coastal hazards.
- Accommodation – measures which suitably address the identified risks.
- Protect – used to preserve the foreshore reserve, public access and public safety, property and infrastructure.

The assessment of these options is generally done in a progressive manner, moving through the various options until an appropriate mitigation strategy is found. Adaptation options can vary depending on the type of asset, and often a range of complementary strategies may be required to mitigate coastal hazard risks.

7.2 Approach Outlined in the City of Busselton CHRMAP

As outlined previously, the City's CHRMAP completed a review of the various options for risk management and adaptation. The recommended outcomes for all of the planning horizons included the construction of a seawall to protect the foredune, infrastructure and buildings. It was noted within the City's CHRMAP that the seawall should be buried and should extend from the western end of the beach, eastwards to a point between the most eastern beach access path and Gunyulgup Brook.

Whilst an image showing the extent of the proposed seawall was not provided, it is interpreted that the proposed extent of the seawall should be as shown in Figure 7.2. It should be noted that the extent shown in Figure 7.2 is not intended to be interpreted as a potential alignment for the seawall.

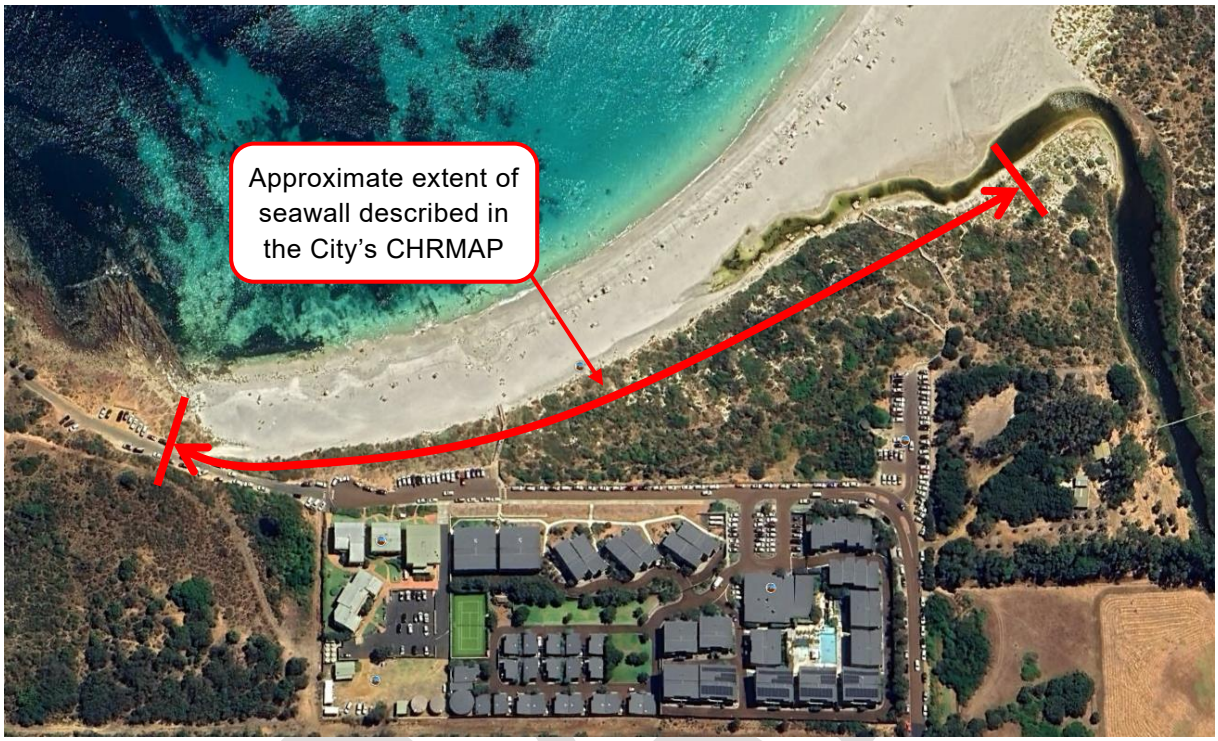

Figure 7.2 Extent of Seawall Described in the City's CHRMAP

From a coastal engineering perspective, the extent of the seawall described in the City's CHRMAP appears sound to provide protection to the existing infrastructure and the Smiths Beach project. Fundamentally, the two elements of the seawall extent that are most critical to the success of the structure are (1) the connection of the seawall to the existing rock at the western end, and (2) ensuring that the seawall extends an adequate distance past the areas intended to be protected (at the eastern end) to ensure that flanking erosion around the seawall termination does not impact the areas intended to be protected.

Focusing on the western end, an important consideration is to ensure that the seawall is adequately tied in with the natural rock to provide a continuous level of protection. If a gap was to be left between the natural rock and the seawall this area would potentially be prone to flanking erosion that could compromise the integrity of the protection and impact any adjacent development. In the case that the revetment was not tied in with the natural rock, the seawall would need to be extended in a landward direction to appropriately protect against potential flanking erosion around the end of the structure. On review, tying in with the existing natural rock would provide a more consistent level of protection.

7.3 Protection of Proposed Development

The recommended protection approach outlined within the City's CHRMAP would provide protection to the proposed development as well as any foreshore areas that were landward of the seawall. However, it is important to note that there is a balance that must be considered when locating the seawall within this area.

The location of the seawall needs to balance:

- the ability to tie in with the protection for the existing development (including Smiths Beach Road, Canal Rocks Beachfront Apartments and the Smiths Beach Resort);
- retention of a sandy beach in front of the seawall for as long as possible (i.e. being as far away from the coast as possible); and
- the provision of adequate foreshore width behind the seawall after the shoreline erodes such that there is useable foreshore space available for public.

Several possible alignments were considered for the seawall, including alignments shown in Figure 7.3.

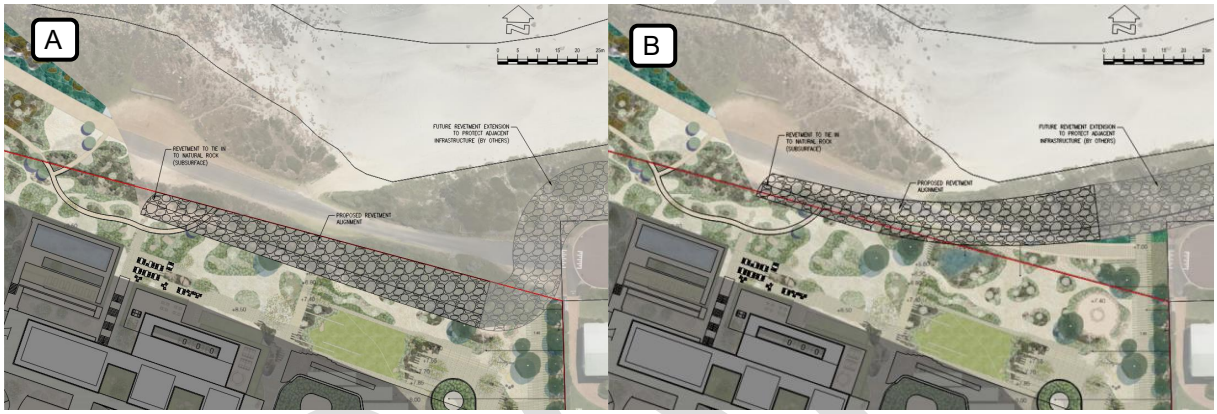

Figure 7.3 Potential Seawall Alignment Options

The various options considered vary in their alignment and how they would allow for the potential tie in with the future extension of the seawall to protect existing infrastructure including Smiths Beach Road. Option A would locate the physical footprint of the seawall within the Site. The benefit of this option would be that it would locate the seawall well back from the coastline and would therefore provide the maximum period possible before the seawall would become exposed in this location. Notwithstanding this fact, the level of vulnerability of the existing infrastructure, including Smiths Beach Road, would likely mean that protection of these assets (by the responsible management authority) would be required and this protection would be exposed well before the seawall constructed within the Site.

Option B would allow for the construction of a more continuous seawall alignment that would tie in well with future protection (by the responsible management authority) in front of the existing development, however the negative aspect of this option is that it would potentially result in an earlier exposure of the seawall.

Upon review of the options, it was concluded that the alignment which provided the best outcome with respect to the above considerations is Option A, the construction of the seawall within the Site. A more detailed view of this plan is shown in Figure 7.4.

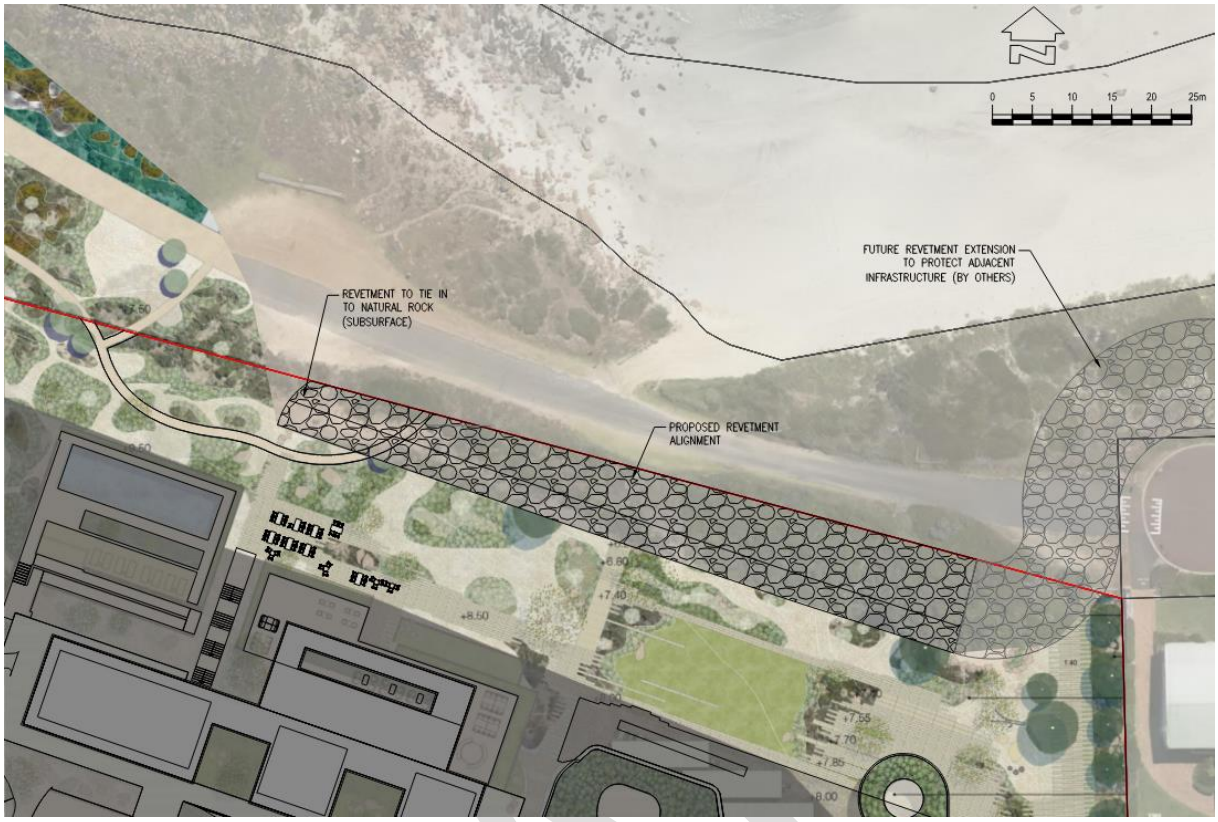

Figure 7.4 Proposed Alignment for the Construction of the Seawall

The intention with the construction of this seawall would be that the seawall would initially be buried, in line with the recommendations of the City's CHRMAP. This would enable the entire foreshore area to remain available for public use. Thereafter, at the point when/if the shoreline erodes back to the alignment of the seawall then this structure would ultimately provide the protection to the remaining foreshore area. As shown in Figure 7.4 this would retain a public foreshore reserve in the order of 20 m wide to accommodate foreshore uses.

With respect to the timing for the construction of the seawall, the City's CHRMAP identifies that construction of the seawall is expected to be required within the immediate planning timeframe from "current – 2043". However, discussions with the City have identified that they currently do not have funding to complete the construction of this seawall.

As identified by the vulnerability assessment, in the absence of this seawall, the risk posed to the proposed development within the 100 year planning timeframe is too high. Therefore, based on precedence from other developments in Western Australia, it is incumbent on the Proponent to ensure that adequate protection is in place prior to construction. The responsibility for the construction of the seawall fronting the proposed development site will therefore fall to the Proponent.

Construction of the initial section of the seawall by the Proponent will therefore allow the City to continue the protection in front of the existing infrastructure (including Smiths Beach Road, Canal Rocks Beachfront Apartments and the Smiths Beach Resort) when required. The design and construction of the seawall within the Site would be cognisant of this requirement and would ensure that the future tie in would be well planned and detailed.

7.3.1 Impact of Proposed Seawall on Coastal Processes

As part of the design and construction process for any coastal structure there is a requirement to consider the potential impacts of that structure on the surrounding coastal processes. In this case, the seawall is proposed to be constructed at the very southern end of the Smiths Beach Embayment, immediately adjacent to the existing natural rock shoreline. Figure 7.5 shows the location of the seawall in the context of the overall embayment.

Figure 7.5 Location of Proposed Seawall Within the Smiths Beach Embayment

When reviewing the potential impact of the seawall on the local coastal processes it is important to understand the local dynamics of the area.

The alignment of the shoreline within the embayment is heavily influenced by existing shoreline controls, including the natural rock headlands and rock reefs. Significantly, the alignment of the shoreline at the southern end of the embayment (adjacent to the proposed seawall location) is reflective of the predominate swell wave direction that arrives at the shoreline following refraction and diffraction around the rock headland (as evidenced by the presence of cusps on the beach in available aerial images). This, combined with the fact that here has been no perceivable change in the alignment of the shoreline for the period between 1988 to present (Bishop-Taylor et al. 2025), indicates that the shoreline in this area is well aligned with the direction of incident wave energy.

This outcome is further supported by the findings of Hsu and Silvester (1993) who investigated the formation and persistence of rhythmic shoreline features, such as crenulate-shaped beaches, through self-organizing processes. Hsu and Silvester (1993) found that crenulate shaped beaches, characterised by their rhythmic, scalloped shoreline planforms, exhibit a high degree of

morphological stability even under erosional conditions. This behaviour can be attributed to the self-organising nature of coastal sediment transport processes.

Their research showed that such shoreline forms emerge through natural feedbacks between obliquely incident wave energy and alongshore sediment transport. In systems where rocky headlands serve as fixed control points, these features further reinforce the persistence of the crenulate form. The rocky headlands act as non-erodible boundaries that anchor the planform geometry, while the adjacent embayed beaches adjust dynamically in response to changes in wave conditions or sediment supply.

As a result, crenulate-shaped coastlines with rock headlands often demonstrate resilience to moderate erosion events. While the sandy embayment may retreat landward due to sea level rise, the presence of non-erodible headlands ensures that the rhythmic planform of the beach is retained.

As the overall direction of wave energy in this area is unlikely to change it is expected that the existing shoreline controls would maintain a shoreline alignment very similar to that which currently exists, even if the shoreline erodes. Consequently, the construction of the seawall would have no influence on the alignment of the shoreline within the broader embayment.

7.4 Impact of Risk Mitigation Strategies on Coastal Vulnerability

If the strategy for the mitigation of coastal erosion risk, as outlined previously, is implemented then this will greatly reduce the likelihood of coastal hazard impacts.

With regard to coastal erosion impacts, the implementation of the proposed seawall would reduce the likelihood of impacts to the proposed development and sections of the foreshore to rare. This would consequently drop the risk and vulnerability ratings to low for the proposed development as well as the portion of foreshore located landward of the seawall. Based on this, an updated assessment of vulnerability is provided in Table 7.1. The risk ratings for the other assets would remain the same until such time as the City constructs the seawall to protect these assets.

Table 7.1 Assessment of Vulnerability of Coastal Erosion Impact

Key Asset	2043	2073	2123
Smiths Beach Road (including Parking)	Medium	Medium	High
Foreshore (seaward of seawall)	Medium	Medium	Medium
Foreshore (landward of seawall)	Low	Low	Low
Canal Rocks Beachfront Apartments	Low	Medium	Extreme
Smiths Beach Resort	Low	Medium	Extreme
Proposed Development Area	Low	Low	Low

8. Implementation Plan

The risk mitigation and adaptation strategy outlined in Section 7 set out the general proposed coastal management approach for the development. Direct guidance on when, what, how and by who these processes will be completed is provided within this implementation plan. For ease of reference, these details have been broken down to outline the requirements for each stage of the project and / or asset life.

8.1 Planning, Design & Construction

As outlined in Section 7, the responsibility for the design and construction of the seawall would rest with the Proponent. Details of the required tasks, timing and confirmation of this responsibility are provided in Table 8.1.

Table 8.1 Implementation Plan – Planning, Design & Construction

Requirement	Timing	Responsibility
Consultation with the City and other key stakeholders to determine the structural requirements of the seawall.	Planning & Design Phase	The Proponent (supported by design team)
Appropriate design of the portion of seawall fronting the proposed development.	Planning & Design Phase	The Proponent (supported by design team)
Development of suitable plans for the foreshore landscaping to respond to the location of the seawall. For example, locating more expensive infrastructure landward of the seawall.	Planning & Design Phase	The Proponent (supported by design team)
Construction of the seawall, including revegetation and/or landscaping over the buried structure	Construction Phase	The Proponent (supported by design team)

8.2 Operational Phase

Future erosion of the shoreline would lead to a loss of foreshore reserve up until the point when the seawall becomes exposed. The loss of foreshore reserve will have impacts on any of the landscaping assets located within it. As a result of this there will be a requirement to modify the foreshore and remove and / or relocate any assets as they become vulnerable. A planned approach to the management of these landscaping assets will have been developed as part of the planning and design phase for the project. It will be the responsibility of the City to manage these assets in the future.

Over the working life of the seawall there will be a requirement to complete maintenance of the structure to ensure its ongoing integrity and ability to function as designed. Nevertheless, there will be no requirement to complete maintenance of the structure whilst it is buried. Maintenance would only be required when the seawall becomes exposed and experiences damage – at which point it is anticipated that the City would have completed the construction of adjacent sections of the seawall.

The requirements over the operational phase are summarised in Table 8.2.

Table 8.2 Implementation Plan – Operation

Requirement	Timing	Responsibility
Remove and / or relocate landscaping assets within the foreshore.	When at risk of erosion impacts.	City of Busselton
Seawall maintenance when required.	When asset management indicates it is required.	City of Busselton

8.3 Review of CHRMAP Guidelines

Should the State Government guidance for the determination of the required coastal hazard allowances change as a result of new information becoming available, the Coastal Hazard Assessment and this CHRMAP should also be reviewed. This is especially the case for information regarding climate change and projected sea level rise. The responsibility for both of these actions would rest with the City.

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