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R1763 Rev 2

July 2023

Rowe Group

Albany Woolstores
Coastal Hazard Risk Management & Adaptation Plan

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Executive Summary

Rural Logistics (WA) Pty Ltd is exploring opportunities to develop an area of land on Woolstores Place, Mount Elphinstone which is located within the City of Albany. Current works include preparation of a structure plan for the development.

Within Western Australia, State Planning Policy 2.6: State Coastal Planning Policy (SPP2.6; WAPC 2013) provides guidance on the assessment of coastal hazard risks for assets or infrastructure located near to the coast. The objectives of SPP2.6 are wide ranging, however a key component of SPP2.6 is the identification of appropriate areas for sustainable use of the coast. This includes use for commercial and tourism purposes, which is relevant to the preparation of a structure plan for the Wool Stores site. Assessment of potential coastal hazard risks and adaptation strategies is a requirement to support the preparation of a structure plan. This report has been prepared to review the coastal hazard risks and develop suitable adaptation strategies for the future development.

The City of Albany are currently in the process of preparing a broader Coastal Hazard Risk Management and Adaptation Plan (CHRMAP) for Princess Royal Harbour. Through this process, details have been provided regarding the potential coastal hazard impacts at the Wool Store site. It is noted that at this stage the coastal hazard details that have been provided are based on the Vancouver Peninsular isthmus not being protected. As a result, the coastal hazard lines contemplated in this report are potentially conservative.

In addition to the details regarding the coastal hazards, the City also provided details of community and stakeholder consultation that has been completed. This consultation identified that the primary uses of the foreshore around the Wool Stores site are predominately walking and cycling.

Specifically for the Wool Stores structure planning process, further consultation has been completed with the Public Transport Authority (PTA), ARC Infrastructure and other Government Stakeholders. This consultation has been focused on the future infrastructure requirements associated with the Albany rail line and Princess Royal Drive, which run immediately adjacent to the Wool Stores site. Exact details are still to be determined; however it is clear that future protection of these assets would be ensured, and it is expected that this would occur through construction of an extension to the existing rock revetement structure that provides protection along the northern shores of Princess Royal Harbour.

Completion of a coastal hazard risk assessment for the different elements shown in the development concept for the Wool Stores, as well as the adjacent assets surrounding the site, identified that the highest risk asset was the rail line. As determined during the consultation, protection of this asset will be completed in the future, however ensuring that the necessary level of protection is provided would not be possible without construction of a seawall through the Wool Stores site. As a result, a more beneficial alignment for the seawall has been developed which would ensure continuous protection to both the rail line and the Wool Stores site.

The proposed alignment of the seawall would generally match the alignment of the existing seawall structure around the Wool Stores. As a result, there would be no further encroachment into Princess Royal Harbour, nor would there be any additional effects on the shoreline movement since the footprint of the construction would be largely similar.

Construction of a seawall similar is to occur prior to new titles being created out of any approved subdivision application for the structure plan area. Funding and ongoing maintenance of the

seawall would be undertaken by the developer, PTA, ARC Infrastructure and Main Roads Western Australia. However, there will be allowance for subdivision and development to occur over Lots 1 and 2 should the Vancouver Peninsular isthmus be protected as a result of the City of Albany's CHRMAP process, as protection of the isthmus would mean that these lots and adjoining roads would be located outside of the 100 year horizon for erosion impact.

With respect to inundation hazards, the proposed approach would be to fill the proposed development sites to an elevation of at least 2.5 mAHD to avoid inundation risks.

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1. Introduction

Rural Logistics (WA) Pty Ltd (Rural) is exploring opportunities to develop an area of land on Woolstores Place, Mount Elphinstone which is located within the City of Albany (City). Current works include preparation of a structure plan for the development. The site is bound by Princess Royal Drive, Frenchman Bay Road, and the Princess Royal Harbour Waterfront. The site locality is presented in Figure 1.1 below.

Figure 1.1 Site Locality

The City previously engaged consultants Water Technology (2022) and Cardno (2022) to complete Coastal Hazard Risk Management and Adaptation Planning (CHRMAP) to provide guidance for planning and management along the Princess Royal Harbour coastline, which includes the development area of interest. The first two stages of the CHRMAP were completed in 2022. M P Rogers & Associates Pty Ltd (MRA) have been engaged via Rowe Group (Rowe) to complete a CHRMAP specific to the Woolstores Place development.

This report provides a summary of the following.

- Key outcomes from the City's CHRMAP.
- Key outcomes from meetings with relevant stakeholders.
- Coastal hazard identification and vulnerability.
- Likelihood and consequences of impacts from assessment of coastal erosion and inundation on each of the key assets.
- Proposed adaptation and mitigation strategy.
- Proposed coastal monitoring strategy.

This report is intended to provide guidance regarding the risks posed by coastal hazards.

1.1 Coastal Hazard Assessment Requirements

Within Western Australia, State Planning Policy 2.6: State Coastal Planning Policy (SPP2.6; WAPC 2013) provides guidance on the assessment of coastal hazard risks for assets or infrastructure located near to the coast. The objectives of SPP2.6 are wide ranging, however a key component of SPP2.6 is the identification of appropriate areas for sustainable use of the coast. This includes use for commercial and tourism purposes, which is relevant to the preparation of a structure plan for the Wool Stores site.

The guidance on the assessment of coastal hazard risk is provided within SPP2.6 in the form of a methodology to assess the potential extent of coastal hazard impacts, as well as for the development of a CHRMAP. Further details in this regard are also provided in the CHRMAP Guidelines (WAPC 2019).

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

2. Context

2.1 Purpose

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

SPP2.6 requires that the responsible management authority or development proponent prepares 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 that could be vulnerable to coastal hazards and to outline the preferred approach for 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 development proponent, with agreement from the appropriate 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.

- Confirm the specific extent of coastal hazards in relation to the proposed structure plan area.
- Outline the coastal hazard risks associated with the structure plan area and how these risks may change over time.
- Establish the basis for present and future risk management and adaptation, which will be used to inform the proposed structure plan.
- Provide guidance on appropriate future management and adaptation planning for the proposed structure plan area, including monitoring.

2.2 Objectives

The key objectives of this plan are as follows.

- Inform the proposed structure plan by providing appropriate guidance to the proponents and key stakeholders with respect to the management of coastal hazards.
- Ensure the proponent and key stakeholders understand the potential likelihood, consequence and subsequent risks to assets identified within the structure plan being impacted by coastal hazards over each planning horizon.
- Outline the required coastal adaptation approach in a project-specific Implementation Plan for the proponent and that is acceptable to key stakeholders.

2.3 Scope

The CHRMAP Guidelines (WAPC 2019) 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 and adaptation process.

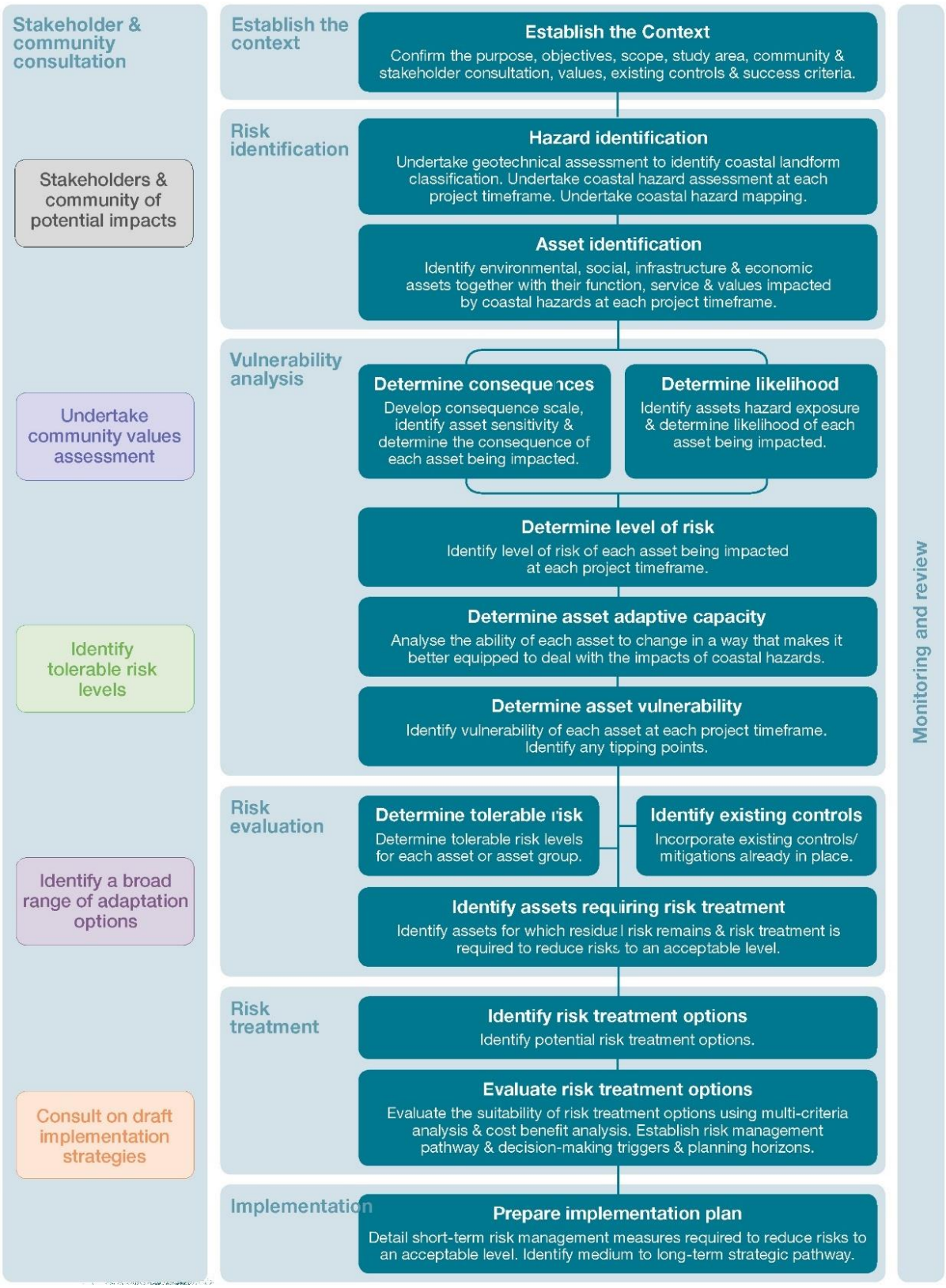


Figure 2.1 Risk Management & Adaptation Process Flow Chart (WAPC 2019)

As presented in the flowchart, the process for the development of a meaningful CHRMAP 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 management of coastal hazard risk associated with the proposed structure plan area will be required to present a proposed adaptation plan that is acceptable to the stakeholders. As a result, the approach that has been taken for this plan is to develop a management methodology that allows for flexibility into the future.

The development of the adaptation plan will be informed by the assessment of the coastal erosion and inundation hazards at the site. The identification of the coastal erosion and inundation hazards at the proposed site is presented within Section 3 of this report.

This CHRMAP will consider the potential risks posed by coastal hazards over a range of horizons covering the 100 year planning timeframe, as required by SPP2.6 for development on the coast.

Intermediate planning horizons will be considered in order to assess how risk profiles may change in the future and to inform the requirement for adaptation strategies. This is particularly significant where these intermediate planning horizons more closely align with the expected service lives of the proposed redevelopment assets. The intermediate planning horizons that will be considered in this CHRMAP are presented below, with the present day taken as 2022 (the time that this CHRMAP process was initiated).

- Present day (2022)
- 2047
- 2072
- 2122

Based on the results of the risk assessment, risk mitigation strategies will be developed, where required, in order 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 vulnerability 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 considered to be a guide for future requirements.

The actual requirement for the implementation of these management actions should ultimately be informed by a coastal monitoring regime. The purpose of this coastal monitoring regime is to identify actual changes in the shoreline or sea level that could alter, either positively or negatively, the risk exposure of the proposed assets and infrastructure. A recommended coastal monitoring regime is included within the Implementation Plan, presented within Section 8 of this report.

2.4 The Site

The proposed structure plan area is located along the sandy coastline of the Princess Royal Harbour, approximately 2 km west of the Albany city centre. The key asset within the structure plan area is the Albany Wool Stores and the road reserves.

Residential and commercial properties are located on either side of the structure plan area, buffered by nature reserves, and a railway track for transportation runs to the east of and behind the lot just outside of the development boundary. Identified key existing assets are Princess

Royal Drive, the Railway Track and the Woolstores Place Roundabout. Rock protection infrastructure exists adjacent to Woolstores Place and Frenchman Bay Road.

The key assets, both existing and proposed, are summarised in Table 2.1 below.

Table 2.1 Key Assets

Proposed Redevelopment Assets[1]	Plan Colour Code (Refer to Figure 2.2)
Lots 1 & 2	Green
Lots 3 – 6	Blue
Lots 7 – 9	Yellow
Existing Assets	
Princess Royal Drive	
Railway Track	
Woolstores Place Roundabout	

Note:1. Road reserves, drainage and other related services are considered as part of the relevant lots.

The figure below presents an extract of the proposed conceptual development plan, with the different assets noted. The concept plan is also included in Appendix C.

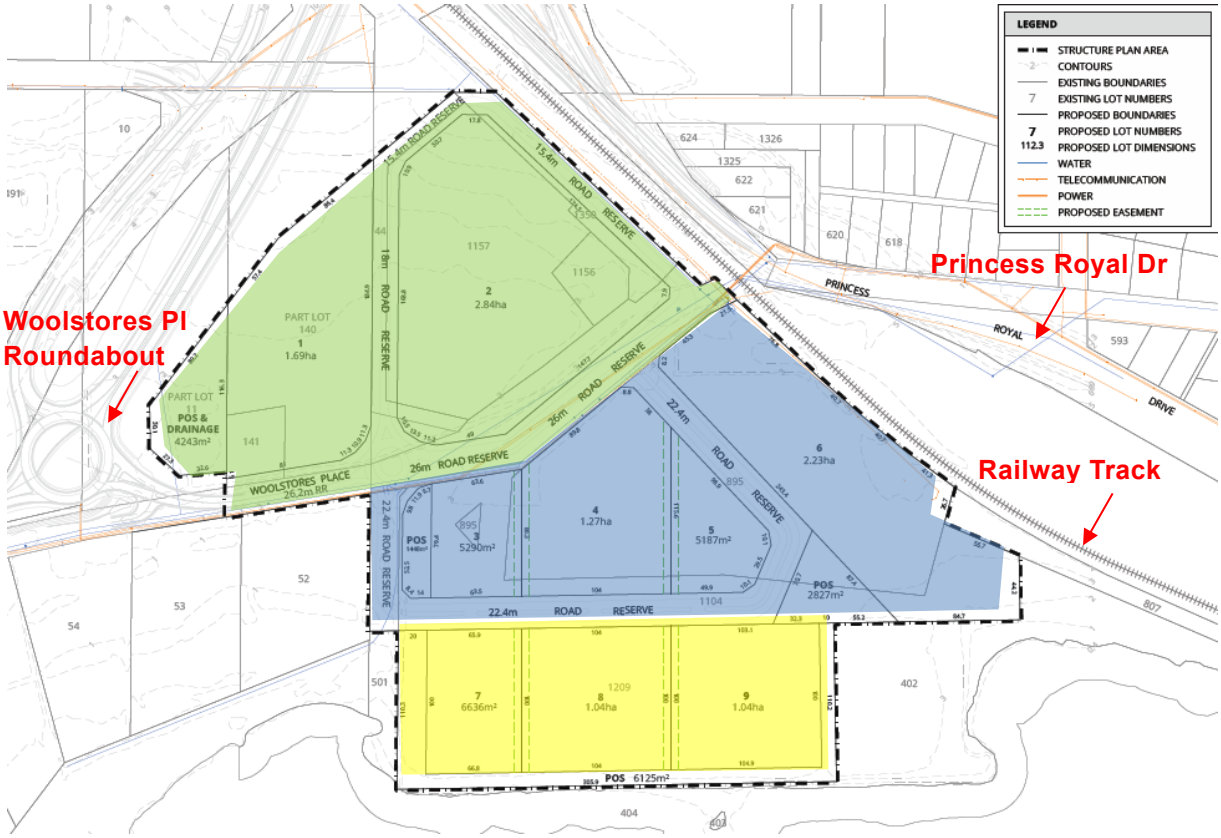


Figure 2.2 Development Concept Plan Draft (Rowe 2023)

2.5 Stakeholder Engagement

The key stakeholders relevant to the proposed structure plan are as noted below.

- The City
- Department of Planning, Lands and Heritage (DPLH)
- The Client (Rural)
- The Planner (Rowe Group)
- Main Roads Western Australia (MRWA)
- Public Transport Authority (PTA)
- ARC Infrastructure
- Existing residential owners

In 2022, Water Technology were engaged by the City to commence the CHRMAP process for Princess Royal Harbour, which encompasses the Wool Stores area. The engagement of Water Technology was to establish the context for the overall CHRMAP process, which included stakeholder and community engagement. The stakeholder and community engagement was completed by Element on behalf of Water Technology. This engagement was completed to

capture the coastal values of the community, inform the public about coastal hazards and the CHRMAP process and gauge attitudes towards the various adaptation options available.

The stakeholder consultation process consisted of a range of different engagement techniques, including:

- a coastal values survey;
- an information session;
- a letter drop;
- social media posts;
- an email campaign; and
- establishment of a community and Business Reference Group.

One of the outcomes from the engagement was the identification of different activities that respondents most commonly undertake along different sections of the shoreline within Princess Royal Harbour. The shoreline was broken into different sections, as shown in Figure 2.3. Most significantly, the most common uses for Section A (which covers the Wool Stores) were *Visiting a venue (26%)* and *Walking (22%)*, while for Section B (which neighbours the Wool Stores) the most common uses were *Walking (29%)* and *Cycling (24%)*. The identification of these uses is considered to be reflective of the types of shorelines that exist within these locations.

Figure 2.3 Shoreline Sections within Princess Royal Harbour

The shoreline within Section A almost entirely consists of coastal protection structures. This provides an opportunity for public amenities such as venues and walking / cycling paths to be located in close proximity to the Harbour edge. Within Section B, the shoreline predominately consists of a gently sloping coastline with vegetation extending up to the water's edge. Given it's morphology, this shoreline is typically not associated with active recreation as much as other shorelines within Princess Royal Harbour, such as Section D, which is predominately sandy.

In addition to these findings, an intercept survey following the information session identified that it was generally very important to respondents that:

- In 20 years, the land in the coastal zone associated with the harbour will be provided for foreshore management, public access, recreation and conservation.
- In 20 years, land is the coastal zone associated with the harbour will have reduced risk associated with erosion.
- In 20 years, land in the coastal zone associated with the harbour (land at risk of coastal erosion and inundation) will be managed to avoid inappropriate land use and development.
- In 20 years, land in the coastal zone associated with the harbour will be managed to ensure land use and development does not accelerate coastal erosion or inundation risks or have a detrimental impact on the functions of public reserves.

Beyond the scope of the CHRMAP being completed for the City, specific consultation has been completed for the Wool Stores development. Consultation has been completed with the City and DPLH to understand the requirements and impact of the proposed redevelopment. This consultation highlighted the requirement to consider the likely future coastal response for neighbouring infrastructure. Specifically, this includes Princess Royal Drive, which is the primary road access to the Albany Port, and the Albany rail line. Both of these assets are considered to be essential to the future operation of the Port, both now and into the future. This is evidenced by the fact that these assets are protected by a rock revetment seawall around the perimeter of Princess Royal Harbour, though it is noted that there is a small section that would still require protection adjacent to the Wool Stores.

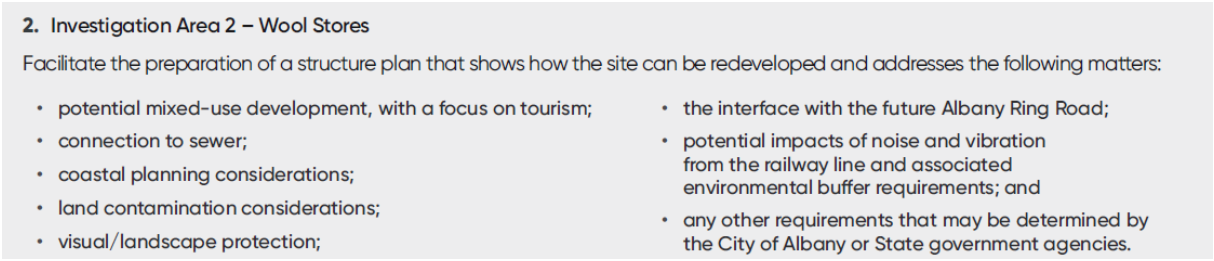
To better understand the future coastal adaptation plans for this infrastructure, in particular the rail line, the project team for the Wool Stores development have met with the Public Transport Authority (PTA) and ARC Infrastructure. Exact details are still to be determined; however it is clear that future protection of the assets would be ensured, and it is expected that this would occur through construction of an extension to the existing rock revetement structure.

2.6 Existing Planning Policies

There are a number of planning requirements and controls to be considered for the preparation of a structure plan over the Wool Stores, noted below.

- Albany Local Planning Scheme No 1 (LPS No 1)
- City of Albany Policy, Wool Stores Redevelopment Site
- City of Albany Local Planning Strategy (ALPS 2019)
- Environmental Regulations

The proposed structure plan is to be in line with the abovementioned policies as well as other relevant policies. The local policies as mentioned above have identified this redevelopment area as a tourism and residential area and have identified key requirements in terms of land use and development. This CHRMAP has been prepared to support preparation of a structure plan and will aid with preparation of an associated amendment to Local Planning Scheme No. 2 once it has been gazetted. The ALPS notes the key matters to be addressed as part of the LSP, as summarised below.



2. Investigation Area 2 – Wool Stores

Facilitate the preparation of a structure plan that shows how the site can be redeveloped and addresses the following matters:

- potential mixed-use development, with a focus on tourism;
- connection to sewer;
- coastal planning considerations;
- land contamination considerations;
- visual/landscape protection;
- the interface with the future Albany Ring Road;
- potential impacts of noise and vibration from the railway line and associated environmental buffer requirements; and
- any other requirements that may be determined by the City of Albany or State government agencies.

Figure 2.4 Key Requirements for Redevelopment LSP (ALPS 2019)

2.7 Success Criteria

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

- Demonstrated understanding by the proponent and key stakeholders regarding the likelihoods, consequences and subsequent risks 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 the proponent and key stakeholders.
- Adoption of the implementation plan by the proponent throughout the development and operation of the proposed Woolstores Place redevelopment.

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

3. Coastal Hazard Identification

An understanding of the coastal hazards and potential risks is critical for the assessment and determination of management and adaptation actions. Coastal erosion and inundation hazard allowances have been determined in a Coastal Hazard Assessment, to the requirements of SPP2.6, completed by Cardno (2022) and are presented in the following sections.

3.1 Coastal Erosion Hazard Allowances

A Coastal Hazard Assessment was previously completed by Cardno (2022). It was completed in accordance with SPP2.6 and included the determination of coastal erosion hazard lines for the present day (2022), 2047, 2072, and 2122 year planning horizons. These coastal erosion hazard lines were subsequently adopted for use by MRA within this report.

SPP2.6 provides the methodology for completing an assessment of the potential erosion impacts on coastal development in Western Australia. For sandy coasts, which is relevant for the shoreline fronting the proposed structure plan area given the existing seawall is in a poor condition with no ongoing maintenance agreement, this methodology requires consideration of the following coastal erosion hazard allowances.

- Allowance for the current risk of storm erosion (termed S1 allowance).
- Allowances for historic shoreline movement trends (termed S2 allowance).
- Allowance for erosion caused by future sea level rise (termed S3 allowance).
- Allowance for uncertainty (termed S_u allowance).

The calculation of the above allowances is outlined in the Cardno CHRMAP Risk Identification report (2022) and determined the following total erosion hazard allowances for the relevant shoreline fronting the proposed structure plan area. The distances given are calculated from the Horizontal Shoreline Datum (HSD).

Table 3.1 Total Recommended Controlled Erosion Hazard Allowance[1] (Cardno 2022)

Planning Timeframe	S1 (m)	S2 (m)	S3 (m)	S_u (m)	Total Erosion Hazard Allowance (m)
Present day (2022)	0	0	0	0	0
2047	0	0	0	0	0
2072	0	13.8	18	10	46.8
2122	0	41.3	94	20	160.3

Note:
1. Values taken for Chainage 3100 – 3500 from Figure 4-13 (Cardno 2022).
2. Note the numbers in the Cardno report show some inconsistencies with what is stated in the text. There also seems to be some arithmetic issues within the tables.

Table 3.2 Total Recommended Uncontrolled Erosion Hazard Allowance[1] (Cardno 2022)

Planning Timeframe	S1 (m)	S2 (m)	S3 (m)	S_u (m)	Total Erosion Hazard Allowance (m)
Present day (2022)	5	0	0	0	5
2047	5	13.8	4	5	27.8
2072	5	27.5	18	10	60.5
2122	5	55	94	20	174

Note:
1. Values taken for Chainage 3100 – 3500 from Figure 4-13 (Cardno 2022).
2. Note the numbers in the Cardno report show some inconsistencies with what is stated in the text. There also seems to be some arithmetic issues within the tables.

It is noted that in the version of the Cardno report reviewed for this project, there were some inconsistencies between tabulated values and what is stated in the text. There also seems to be some arithmetic issues within the tables. As a result, the coastal hazard lines presented in the report were used for this assessment given the City had previously requested that these lines form the basis of any future assessment.

It is important to understand that these coastal erosion hazard allowances are not intended to be predictions of the future shoreline location, but rather to provide conservative estimations of possible future shoreline retreat that are appropriate for consideration in coastal planning. In particular for this study it is noted that the coastal hazard lines are based on the Vancouver Peninsular isthmus not being protected. If it eventuates that the isthmus is to be protected then these coastal hazard lines will be overly conservative. Nevertheless, these coastal erosion hazard lines will be used for this CHRMAP to inform the potential future risk associated with the proposed Wool Stores redevelopment.

The coastal erosion hazard lines for the relevant shoreline fronting the Wool Stores structure plan area are shown in Figure 3.1. These lines are as received from Cardno (2022) and have not been changed or modified.

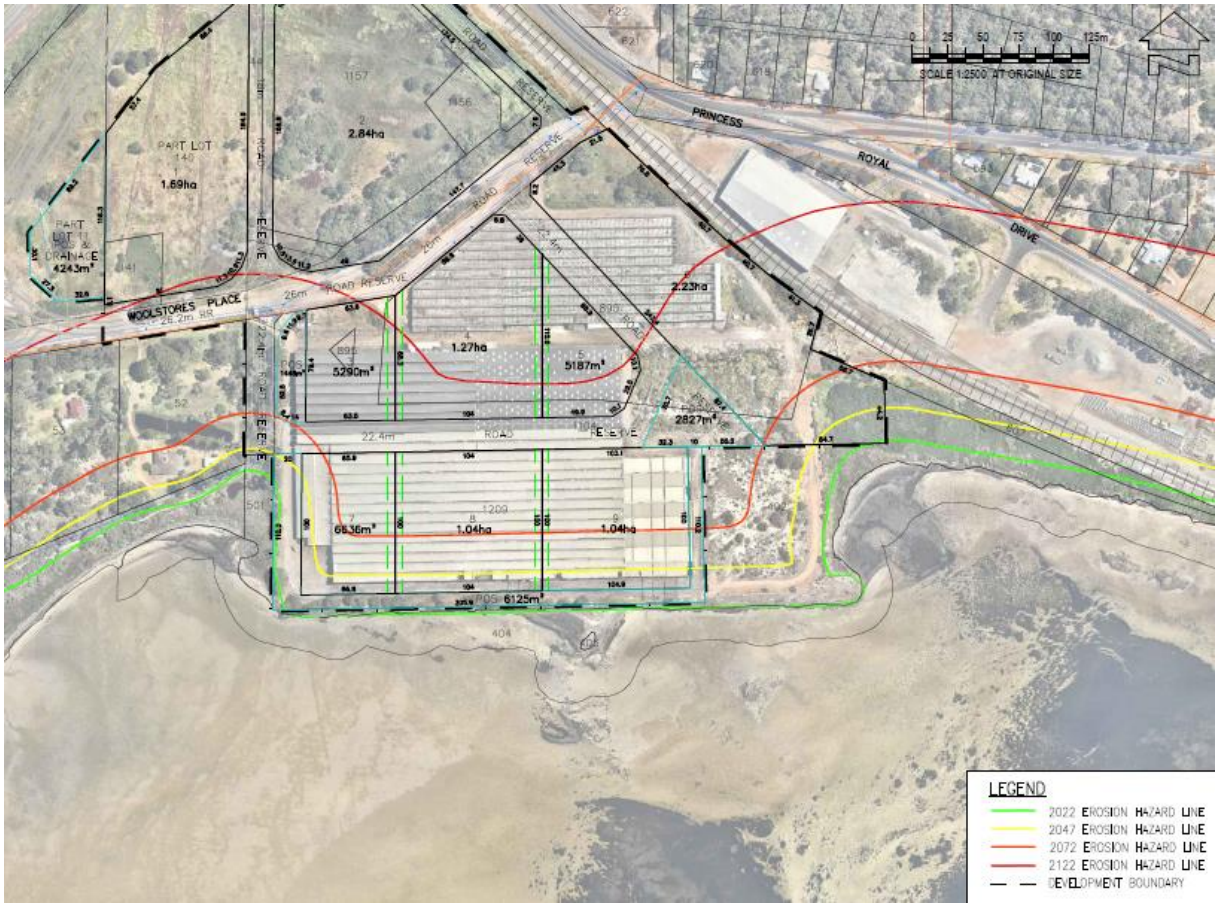


Figure 3.1 Coastal Erosion Hazard Lines

As shown by the figure, the structure plan area is within the potential coastal erosion hazard zones. The consideration of potential coastal erosion hazards therefore needs to be completed to support the planning process for the development.

The proposed structure plan must also consider a number of other factors such as public access, recreation, cultural, and ecological requirements. In some cases, the required setback from the HSD may therefore be greater than the recommended erosion hazard allowances shown in Figure 3.1.

3.2 Coastal Inundation Hazard Allowances

SPP2.6 requires that the allowance for inundation (termed S4 allowance) be taken as the maximum extent of inundation experienced during a water level extent with a 0.2% Annual Exceedance Probability (AEP), which is equivalent to a 500 year Average Recurrence Interval (ARI), plus the appropriate allowance for Sea Level Rise (SLR). This is the critical aspect when considering public safety and significant assets, however for tourist based assets where public safety is managed, consideration of less severe inundation events could be appropriate.

Assessment of the inundation levels requires consideration of peak storm surge, including wave setup. A storm surge occurs when a storm with high winds and low pressures approaches the coastline (refer Figure 3.2). The strong, onshore winds and large waves push water against the coastline (wind and wave setup) and the barometric pressure difference creates a region of high water level. These factors acting in concert create the storm surge. The size of the storm surge is influenced by the following factors.

- Wind strength and direction.
- Pressure gradient.
- Seafloor bathymetry.
- Coastal topography.

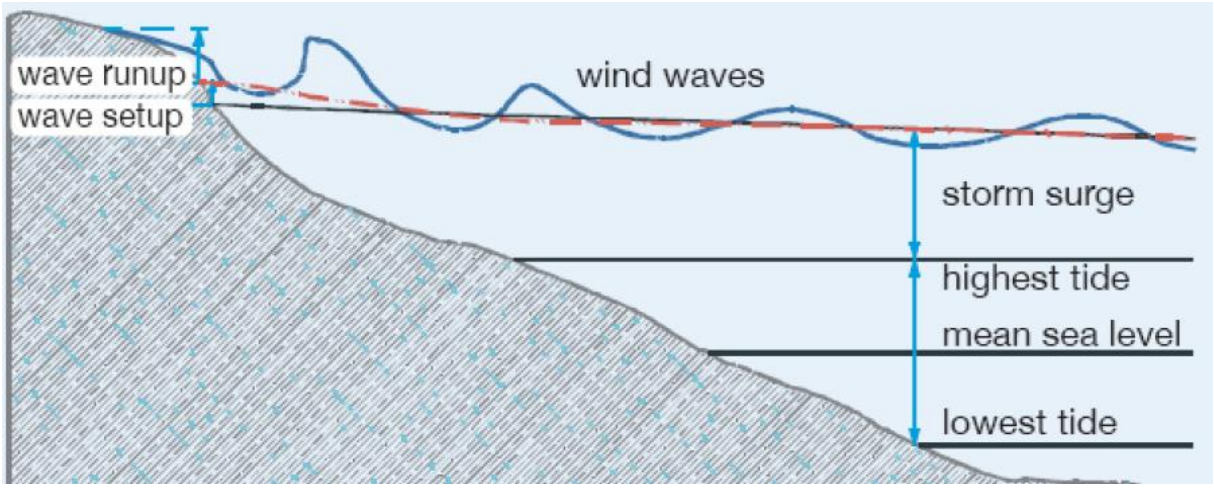


Figure 3.2 Storm Surge Components

DoT (2010) completed an assessment of the potential increase in sea level that could be experienced on the Western Australia coast in the coming 100 years.

The derived SLR scenario was subsequently adopted by the Western Australia Planning Commission (and SPP2.6) for use in coastal planning along the Western Australian coast. This is the SLR scenario adopted for this assessment and is presented in Figure 3.3.

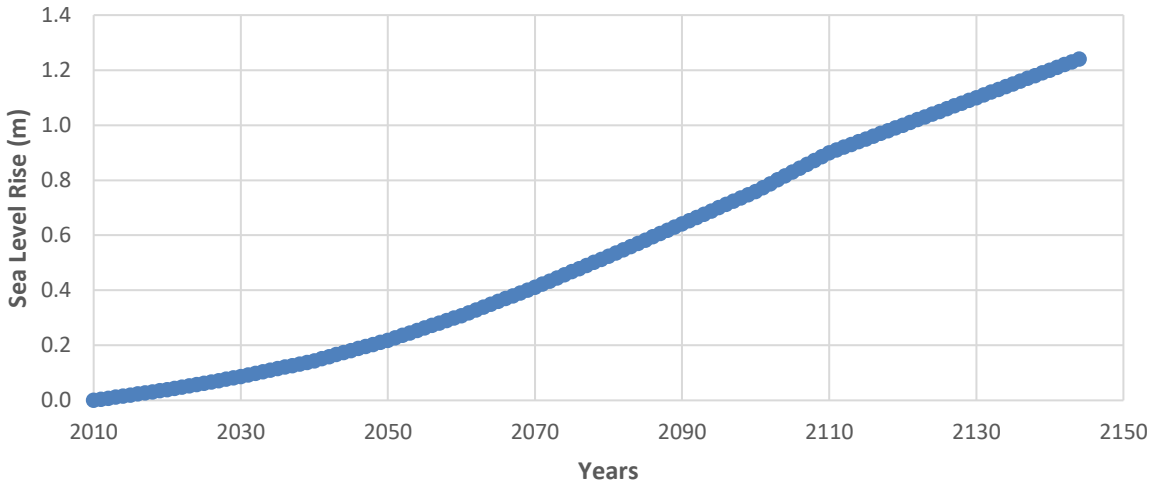


Figure 3.3 Recommended Allowance for Sea Level Rise (DoT 2010)

The total S4 storm surge inundation allowances for the structure plan area, considering the 500 year ARI storm surge water level and the appropriate allowances for SLR (DoT 2010), are provided in Table 3.3 for each of the planning horizons.

As shown in Figure 3.2, wave setup can increase the water levels closer to the shore. Dean and Walton (2008) provide a comprehensive review of wave setup on beaches, which confirms that the majority of setup occurs on the beach face. The Cardno assessment has accounted for a setup of 0.10 m.

Table 3.3 S4 Inundation Levels (Cardno 2022)

Planning Horizon	Potential SLR Allowance (m)	500 year ARI Water Level[1] (mAHD)	Inundation Level[2] (mAHD)
Present day (2022)	0	1.14	1.24
2047	0.15	1.14	1.39
2072	0.35	1.14	1.59
2122	0.94	1.14	2.18

Note:
1. From Cardno (2022).
2. Includes 0.10 m setup.

These potential inundation levels will be considered as part of this CHRMAP to comply with the requirements of SPP2.6.

The inundation hazard lines for the relevant shoreline fronting the Wool Stores structure plan area are shown in Figure 3.4.

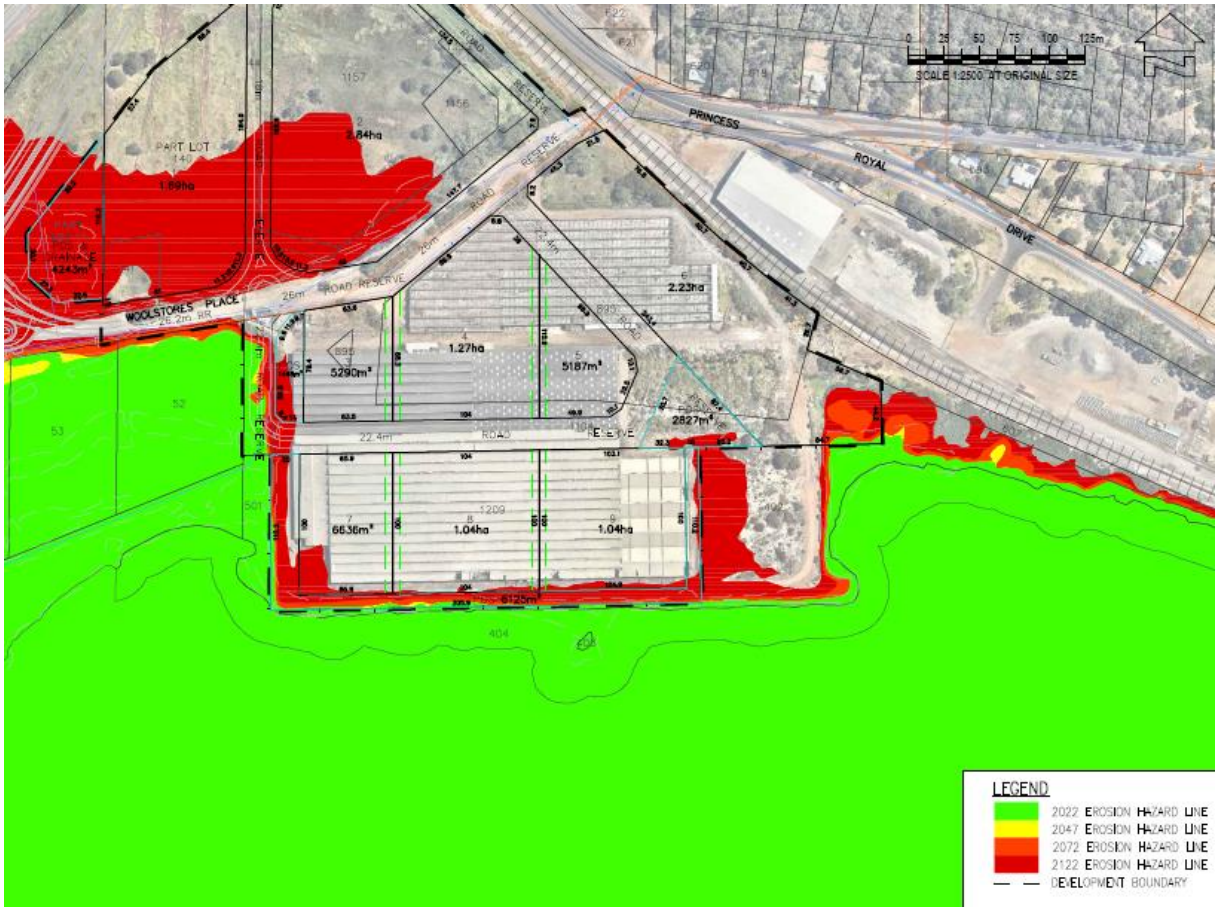


Figure 3.4 Coastal Inundation Areas

As shown by the figure, the structure plan area is generally located landward of the hazard areas. The inundation lines generally sit along the boundary of the structure plan area, with the 100 year planning timeframe showing inundation at a greater risk. The roundabout and inland area west of Woolstores Place is shown to be inundated in 2122.

4. Coastal Vulnerability

The vulnerability of the existing and proposed assets identified previously is related to their level of exposure to coastal hazards, as well as their sensitivity to the impacts caused by these hazards and their ability to respond to them (termed adaptive capacity). With the exception of the environmental assets, which will essentially be left to naturally respond to the impacts of coastal hazards, the assets that are being considered as built form assets and the level of vulnerability of the assets will ultimately be linked to their level of exposure. Further consideration of the risk and future management and adaptation requirements will therefore be needed for these assets. Details of this risk assessment and future management and adaptation requirements are presented in the subsequent sections of this report.

5. Risk Analysis

In accordance with WAPC (2019), a risk based approach will be used to assess the hazards and required mitigation and adaptation options for the proposed Wool Stores structure plan. As coastal hazards are the focus of this assessment, it is the likelihood and consequences of these coastal hazards that need to be considered. As stated previously, it is inherent in the proposal that there be no negative social or environmental impacts as a result of this redevelopment, with mitigation strategies already highlighted to address these issues.

5.1 Likelihood

Likelihood is defined as the chance of something happening (AS/NZS ISO 31000:2009). WAPC (2019) defines 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 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, which follows the Australian Standard Risk Management Principles and Guidelines (AS/NZS ISO 31000:2009). This is presented in Table 5.1.

Table 5.1 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 a result, the likelihood and consequence of erosion and inundation should be considered separately. The likelihood of the coastal hazard impacts is discussed in the following sections.

5.1.1 Coastal Erosion

The likelihood ratings given to the proposed redevelopment assets are based on the coastal erosion hazard lines (Figure 3.1) and the consideration of the probabilities of each of the allowances occurring within the respective planning horizons.

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

- Erosion of 0.2 m/year (uncertainty allowance) in an area not identified as eroding.
- The upper estimate of erosion 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 realised).

Only if all of these occur will the erosion hazard lines be realised.

Table 5.2 Assessment of Likelihood of Coastal Erosion Impact

Key Assets	Present day (2022)	2047	2072	2122
Proposed Assets[1]				
Lots 1 & 2	Rare	Rare	Rare	Rare
Lots 3 – 6	Rare	Rare	Rare	Likely
Lots 7 – 9	Rare	Possible	Likely	Almost Certain
Existing Assets				
Princess Royal Drive	Rare	Rare	Rare	Unlikely
Railway Track	Rare	Possible	Likely	Almost Certain
Woolstores Place Roundabout	Rare	Rare	Rare	Rare

Note:
1. Relevant road reserve sections included in assessment.

The assessment of likelihood of coastal erosion impact shows the following:

- The likelihood of the proposed and existing assets being at risk of erosion impact is expected to be Rare until 2072, with the exception of Lots 7 – 9 and the railway track.
- There is a higher possibility that Lots 7 – 9 and the railway track would be impacted with an increase in exposure level over time.

5.1.2 Coastal Inundation

Assessment of the likelihood of coastal inundation is slightly different to that for coastal erosion. This is due to the fact that the potential for coastal inundation will change in the future as the sea level rises. This means that an area that would only be inundated during a very severe event in the present day could potentially be inundated by a much less severe event in the future.

Assessment of the probability of an area being inundated within a given planning horizon therefore needs to consider the changing probability of event occurrence throughout that planning timeframe.

The results of the assessment of likelihood of coastal inundation for each of the key assets is presented in Table 5.3.

Table 5.3 Assessment of Likelihood of Coastal Inundation Impact

Key Assets	Present day (2022)	2047	2072	2122
Proposed Assets[1]				
Lots 1 & 2	Rare	Rare	Rare	Unlikely
Lots 3 – 6	Rare	Rare	Rare	Unlikely
Lots 7 – 9	Rare	Rare	Rare	Unlikely
Existing Assets				
Princess Royal Drive	Rare	Rare	Rare	Rare
Railway Track	Rare	Rare	Rare	Rare
Woolstores Place Roundabout	Rare	Rare	Rare	Unlikely

Note:
1. Relevant road reserve sections included in assessment.

The assessment of likelihood of coastal inundation impact shows the following:

- The likelihood of the proposed and existing assets being at risk of inundation impact is expected to be Rare until 2072. Beyond this time the risk of impact would increase, with the exception of Princess Royal Drive and the railway track.
- Although the map indicates inundation occurring for certain portions of the Lots and the Woolstores Place roundabout in the 100 year planning timeframe, this is in reality an approximate 10% change of occurrence for the 500 year ARI event and hence has been assigned an Unlikely likelihood.
- It is also likely that the current topography of the structure plan area is slightly higher than the predicted inundation levels, although this information has not been made available to MRA for confirmation.

5.2 Consequence

The second part of the risk assessment is determining the consequence of the coastal hazards on the proposed structure plan area. A scale of consequence has been developed which provides a range of impacts and is generally consistent with the Australian Standard Risk Management Principles and Guidelines (ISO 31000:2009).

Table 5.4 Scale of Consequence

Rating	Social	Economic	Environmental
Catastrophic	Loss of life or serious injury. Large long term or permanent loss of services, employment, finances or culture (75% of community affected), international loss	Damage to property, infrastructure or local economy > $20M	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage
Major	Serious injury. Medium term disruption to services, employment, finances or culture (< 50% of community affected), national loss	Damage to property, infrastructure or local economy > $5M to $20M	Severe loss of environmental amenity and a danger of continuing environmental damage
Moderate	Minor injury. Major short or minor long term disruption to services, employment, finances or culture (<25% of community affected), regional loss	Damage to property, infrastructure or local economy > $500K to $5M	Isolated but significant instances of environmental damage that might be reversed with intensive efforts. Recovery may take several years.
Minor	Small to medium disruption to services, employment, finances or culture (<10% of community affected), local loss	Damage to property, infrastructure or local economy > $50K to $500K	Minor instances of environmental damage that could be revered. Consistent with seasonal variability, recovery may take one year.
Insignificant	Minimal short-term inconveniences to services, employment, finances or culture (<5% of community affected), neighbourhood loss	Damage to property, infrastructure or local economy <$50K	Minimal environmental damage, recovery may take less than 6 months.

Similar to the assessment of likelihood, the consequence rating has been completed separately for coastal erosion and coastal inundation. Typically for infrastructure and assets, the consequences associated with coastal erosion are more significant than those associated with coastal inundation. This arises due to the fact the coastal erosion is generally more permanent and more difficult to overcome than coastal inundation. For instance, if the foundations of a house were undermined by erosion it is likely that the house would fall. However, if a house was inundated, while there may be some damage, structural failure would be less likely.

The consequence ratings for coastal erosion and inundation are outlined in the following sections. These consequence ratings are ultimately provided to inform Rural of the risks given to their future management liabilities.

More importantly, this assessment of the consequence of coastal erosion and inundation has been completed on the basis that the public safety risk is managed during severe coastal events.

5.2.1 Coastal Erosion

The assessed consequences of coastal erosion for each of the planning horizons over the 100 year planning timeframe are outlined in Table 5.5.

Table 5.5 Assessment of Consequence of Coastal Erosion Impact

Key Assets	Present day (2022)	2047	2072	2122
Proposed Assets[1]				
Lots 1 & 2	Insignificant	Insignificant	Insignificant	Minor
Lots 3 – 6	Insignificant	Insignificant	Insignificant	Minor
Lots 7 – 9	Insignificant	Moderate	Major	Catastrophic
Existing Assets				
Princess Royal Drive	Insignificant	Insignificant	Insignificant	Catastrophic
Railway Track	Catastrophic	Catastrophic	Catastrophic	Catastrophic
Woolstores Place Roundabout	Insignificant	Insignificant	Insignificant	Insignificant

Note:
1. Relevant road reserve sections included in assessment.

The proposed Lots and existing assets are generally rated as Insignificant Consequences in the present to medium term planning timeframe, with the exception of Lots 7 – 9 and the railway track.

The map indicates risk of erosion for Lots 7 – 9 from the 25 year planning timeframe, with the majority of the area being within the hazard line. Should there be loss of material or infrastructure damage due to erosion, the Consequences would increase up to Catastrophic. This has been reflected in the table above.

The coastal erosion hazard map shows a part of the railway track as being at risk of eroding in the present day timeframe. As the railway track is the only track to the Port, partial closure or restrictions to the track would result in the whole track being unable to be used. As such, the Consequence is rated as Catastrophic.

Princess Royal Drive is a principal freight route used to access the port and adjacent bulk handling facilities. Although a rock seawall exists along much of its frontage along Princess Royal Harbour, the rock protection does not extend adjacent to the Wool Stores site. Princess Royal Drive is identified as a primary point of access to the Port of Albany (WAPC Lower Great Southern

Strategy 2016), hence the consequence of being impacted is rated as Catastrophic in the 100 year planning timeframe.

5.2.2 Coastal Inundation

The assessed consequence of coastal inundation for each of the key assets and each of the planning horizons is presented in Table 5.6. Similar to erosion, the consequence of inundation changes over the planning horizons due to the likely increased consequence of a higher water level and potentially greater inundation extents as sea level rise are realised over time.

Table 5.6 Assessment of Consequence of Coastal Inundation Impact

Key Assets	Present day (2022)	2047	2072	2122
Proposed Assets[1]				
Lots 1 & 2	Insignificant	Insignificant	Insignificant	Moderate
Lots 3 – 6	Insignificant	Insignificant	Insignificant	Insignificant
Lots 7 – 9	Insignificant	Insignificant	Insignificant	Insignificant
Existing Assets				
Princess Royal Drive	Insignificant	Insignificant	Insignificant	Insignificant
Railway Track	Insignificant	Insignificant	Insignificant	Insignificant
Woolstores Place Roundabout	Insignificant	Insignificant	Insignificant	Minor

Note:
1. Relevant road reserve sections included in assessment.

The proposed Lots and existing assets are generally rated as Insignificant Consequences in the present to medium term planning timeframe, with the exception of Lots 1 & 2 and the Woolstores Place roundabout.

Whilst inundation of the roundabout would cause disruption to local traffic, it is expected that this would be of Minor consequence and could be managed through appropriate traffic management.

The inundation hazard map indicates risk for parts of Lots 1 & 2 in the 100 year planning timeframe. Should there be loss of material or infrastructure damage due to inundation, it is possible that the economic consequences could cost up to approximately $5 M. Hence a Moderate Consequence rating was assigned.

6. Risk Evaluation

6.1 Risk Evaluation 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 WAPC (2014).

Table 6.1 Risk 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	Low

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 6.2.

Table 6.2 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

The risk tolerance scale has been reviewed and accepted for use by the proponent. It shows that the extreme and high risks need to be managed.

6.2 Risk Assessment

The risk assessment for the structure plan area was completed in accordance with the recommendations of AS5334 (Standards Australia 2013), which requires a detailed risk analysis to 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 relevant assets.

6.2.1 Coastal Erosion

Table 6.3 below is a summary of the outcomes from the risk analysis, noting the coastal erosion risk levels for each of the identified key assets.

Table 6.3 Assessment of Risk of Coastal Erosion Impact

Key Assets	Present day (2022)	2047	2072	2122
Proposed Assets[1]				
Lots 1 & 2	Low	Low	Low	Low
Lots 3 – 6	Low	Low	Low	Medium
Lots 7 – 9	Low	Medium	High	Extreme
Existing Assets				
Princess Royal Drive	Low	Low	Low	Medium
Railway Track	Low	High	Extreme	Extreme
Woolstores Place Roundabout	Low	Low	Low	Low

Note:
1. Relevant road reserve sections included in assessment.

6.2.2 Coastal Inundation

Table 6.4 below is a summary of the outcomes from the risk analysis, noting the coastal inundation risk levels for each of the identified key assets.

Table 6.4 Assessment of Risk of Coastal Inundation Impact

Key Assets	Present day (2022)	2047	2072	2122
Proposed Assets[1]				
Lots 1 & 2	Low	Low	Low	Medium
Lots 3 – 6	Low	Low	Low	Low
Lots 7 – 9	Low	Low	Low	Low
Existing Assets				
Princess Royal Drive	Low	Low	Low	Low
Railway Track	Low	Low	Low	Low
Woolstores Place Roundabout	Low	Low	Low	Low

Note:
1. Relevant road reserve sections included in assessment.

7. Risk Adaptation & Mitigation Strategies

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 7.1.

Figure 7.1 Risk Management & Adaptation Hierarchy

These options are generally summarised below:

- Avoid – avoid new development 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 that suitably address the identified risks.
- Protect – used to preserve the foreshore reserve, public access and public safety, property and infrastructure.

The assessment of options is generally done in a progressive manner, moving through the various options until an appropriate mitigation option is found.

7.1 Coastal Adaptation Approach

The potential future movement of the shoreline and risks posed from coastal hazards necessitates the requirement for coastal adaptation and risk mitigation planning. When considering the potential coastal protection requirements of the proposed development site it is also essential to consider the reasonable and likely protection requirements of adjacent infrastructure.

The coastal risk assessment showed that the highest level of coastal hazard risk was associated with the adjacent rail line. Discussions with PTA, ARC Infrastructure and other Government stakeholders are ongoing to determine how best to protect the land via an extension of the existing rock seawall. Details regarding the timing and funding arrangements are also being discussed. These stakeholders acknowledge that continued operation of the rail and surrounding roads will require this protection methodology to be implemented. As a result, avoidance, retreat and accommodation options will not be viable in this area.

Nevertheless, ensuring continual protection of the railway line would mean that any seawall would need to extend landward of the coastal hazard lines. In this particular location that would not be possible unless the seawall was constructed through Rural's land. As a result, the more beneficial alignment for the seawall would be for it to extend around the seaward alignment of Lots 8 to 10 as well, as shown in Figure 7.2. This alignment would help to ensure that the local planning vision with respect to the development of commercial mixed use and tourism development would be possible on the Wool Stores site. Further, through provision of a public promenade and foreshore area immediately landward of the possible seawall alignment, the predominate community uses of this shoreline area, as indicated within the public consultation completed by Element (2022) can be maintained.

At the western end of the site there would be two options for the seawall termination. One option would be to allow the seawall to be extended in front of Lots 2 and 3 to ensure protection of these areas. The second option would be to extend the seawall landward back to the coastal hazard line to ensure continual protection of the development. Both of these options are also shown on Figure 7.2.

The most cost effective and robust means of constructing the seawall would be with the use of a rock revetment. A conceptual cross section for a rock revetment structure is shown in Figure 7.3, though it is noted that a detailed design process would be required to determine the exact requirements for the design. The other benefit of a rock revetment structure in this environment is that the roughness and permeability of the revetment structure would significantly reduce the extent of any wave reflections off the wall. For example, following the design guidance within CIRIA (2007), the reflected wave height off a revetment constructed from two layers of armour rock would be in the order of 20% of the incident wave height. This equates to less than 5% of the total wave energy being reflected off the revetment(as wave energy is not linearly proportional to wave height), meaning that any impacts from the revetment construction would be relatively small, even at termination points.

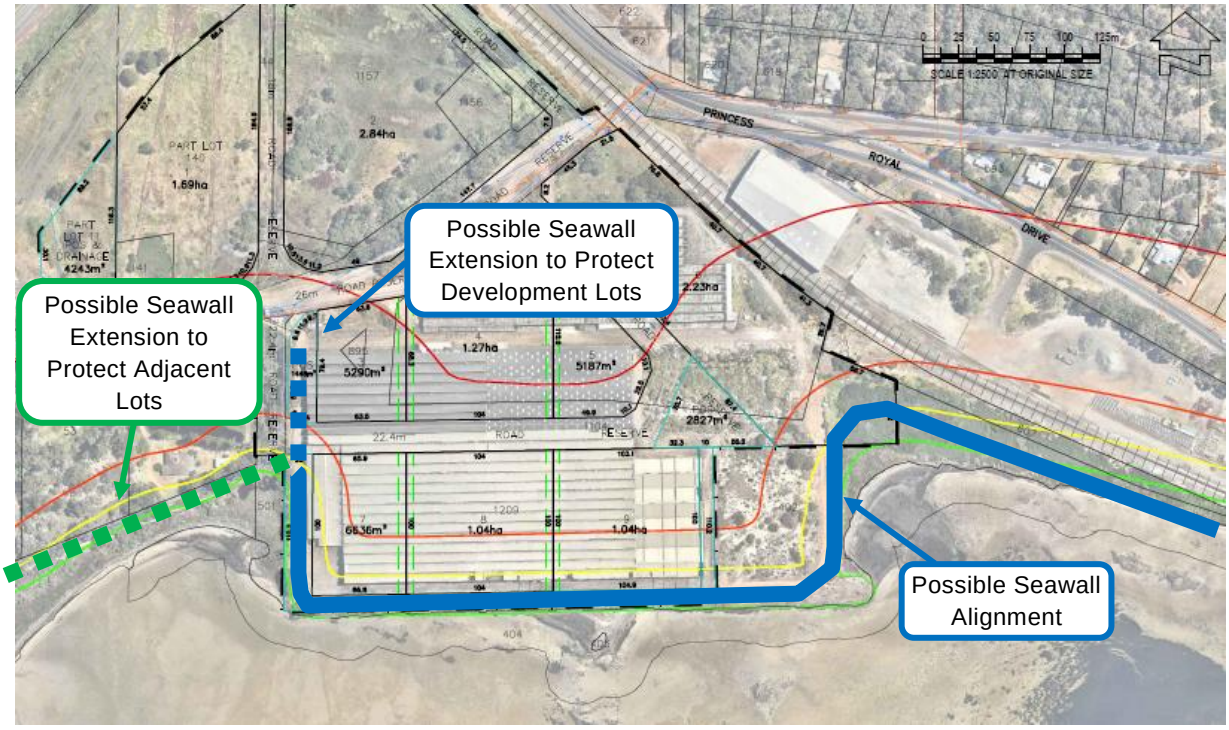


Figure 7.2 Proposed Alignment for Seawall Protection

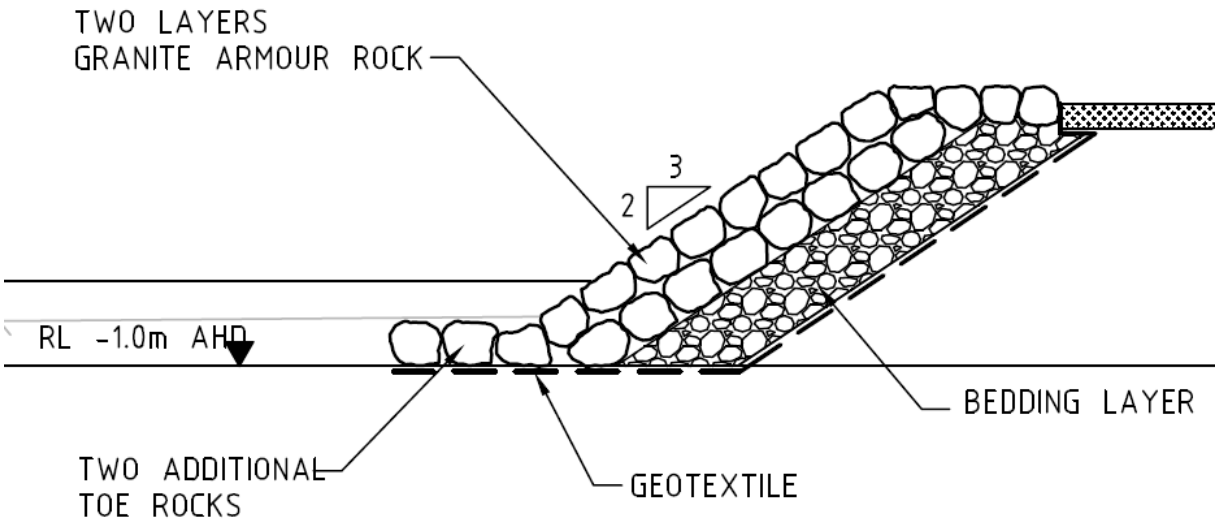


Figure 7.3 Conceptual Cross Section for Seawall Protection

The proposed alignment of the seawall shown in Figure 7.2 would generally match the alignment of the existing structure around Lots 1 & 2. As a result, there would be no further encroachment into Princess Royal Harbour as a result of the construction, nor would there be any additional effects on the shoreline movement since the footprint of the construction would be largely similar.

Construction of a seawall similar to that shown in Figure 7.2 is to occur prior to new titles being created out of any approved subdivision application for the structure plan area. Funding and ongoing maintenance of the seawall would be undertaken by the developer, PTA, ARC Infrastructure and Main Roads Western Australia. However, there will be allowance for subdivision and development to occur over Lots 1 and 2 should the isthmus be protected as a result of the City of Albany's CHRMAP process, as protection of the isthmus would mean that these lots and adjoining roads would be located outside of the 100 year horizon for erosion impact.

With respect to inundation hazards, the proposed approach would be to fill the proposed development sites to an elevation of at least 2.5 mAHD to avoid inundation risks. The requirement for this finished surface elevation comes from SPP2.6 which outlines that development should be located above the 500 year ARI inundation level at the end of the 100 year planning horizon. Based on the inundation levels provided in Table 3.3 this level would be 2.18 mAHD, however it is prudent to provide an additional allowance for local scale wave runup, which could increase this elevation to 2.5 mAHD.

Further details of these proposed approaches are presented in the implementation plan within Section 8.

8. Implementation Plan

The risk mitigation and adaptation strategy outlined in Section 7 set out the proposed coastal management approach for the Wool Stores development. Exact details are still to be determined with respect to seawall construction, however this section outlines the general approach to the implementation of development.

8.1 Planning & Initial Construction

Coastal planning for this development involves mitigating against coastal hazard risks from erosion and inundation. Planning for, and implementation of, the initial construction will be completed on the basis of avoiding coastal hazard risks, in particular, if the City's CHRMAP process determines that protection of the Vancouver Peninsular isthmus will be completed, then there will be an opportunity for the development of Lots 1 and 2 without there being any agreement regarding the construction of the seawall.

A summary of the requirements for the planning and initial construction stage is presented in Table 8.1.

Table 8.1 Implementation Plan – Planning & Initial Construction Stage

Requirement	Timing	Responsibility
Structure planning to identify areas that can be constructed prior to seawall extension and those that require seawall protection prior to construction	Planning Stage	Proponent (supported by engaged design team)
Discussions / negotiations to determine responsibility / funding for the seawall design and construction	Planning Stage	Proponent (supported by engaged design team), City, PTA, ARC Infrastructure and other Government Stakeholders
If the City's CHRAMP process identifies that the Vancouver Peninsular isthmus will be protected then development of Lots 1 and 2 can occur.	Initial Construction Stage	Proponent (supported by engaged design team)
Wool Stores development sites and infrastructure to be filled to avoid inundation risks	Initial Construction Stage	Proponent (supported by engaged design team)

8.2 Operation Over the Infrastructure Service Life - Protect

Following the completion of the planning and initial construction stage, the next stages would not be completed until such time as there was agreement on the construction of the seawall protection. The implementation plan for this stage of the development is outlined in Table 8.2.

Table 8.2 Implementation Plan – Seawall Protection Stage

Requirement	Timing	Responsibility
Formal agreement on the implementation / timing / funding of the seawall protection prior to issuing of titles for any new lots created as a result of the subdivision approval	Prior to development of all lots (possibly excluding Lots 1 and 2, as above)	Proponent (supported by engaged design team), City, PTA, ARC Infrastructure and other Government Stakeholders

Following agreement being reached on the details of the seawall (including alignment, funding, construction timing, etc) and the construction works actually being completed, it will be necessary to ensure that regular monitoring of the seawall is completed. The recommended frequency of monitoring operations is every 5 years.

The seawall is critical at the site as it would provide protection for a number of assets within the development, as well as the adjacent rail and road infrastructure. The requirements during the operation of the seawall are outlined below.

Table 8.3 Implementation Plan – Seawall Operation Stage

Requirement	Timing	Responsibility
Seawall monitoring	Ongoing – to be assessed on a 5 year basis	As agreed in negotiations between the Proponent (supported by engaged design team), City, PTA, ARC Infrastructure and other Government Stakeholders.
Scheduled seawall maintenance	Scheduled maintenance shall be carried out the seawall as required from the results of the condition assessment, but likely every 5 to 10 years.	As agreed in negotiations between the Proponent (supported by engaged design team), City, PTA, ARC Infrastructure and other Government Stakeholders.
Reactive seawall maintenance	Following severe storm events, the seawall shall be checked for any damage and repaired accordingly	As agreed in negotiations between the Proponent (supported by engaged design team), City, PTA, ARC Infrastructure and other Government Stakeholders.
Asset accommodation in the form of seawall upgrades	If risks to the seawall are intolerable	As agreed in negotiations between the Proponent (supported by engaged design team), City, PTA, ARC Infrastructure and other Government Stakeholders.

9. Conclusion

This CHRMAP has been prepared to provide guidance to the development of the Albany Wool Stores site with respect to the future management of coastal hazard risks.

Details of potential coastal hazard impacts have been provided by the City based on the outcomes from their CHRMAP process for Princess Royal Harbour. The details that have been provided are on the basis that the Vancouver Peninsular isthmus is not protected in the future and as a result are potentially overly conservative for this site if the isthmus is to be protected.

This CHRMAP process has identified that there is a reasonable and likely requirement that infrastructure adjacent to the Wool Stores site, which includes the Albany rail line, will need to be protected in the future. The opportunity for beneficial protection of these assets in combination with the protection of the Wool Stores site has been identified and is a viable opportunity to provide beneficial outcomes for all assets, including allowing the realisation of the overall local planning vision for the Wool Stores. A beneficial alignment of a seawall has been developed that would ensure continuous protection to both the rail line and the Wool Stores site.

The proposed alignment of the seawall would generally match the alignment of the existing seawall structure around the Wool Stores. As a result, there would be no further encroachment into Princess Royal Harbour, nor would there be any additional effects on the shoreline movement since the footprint of the construction would be largely similar.

Construction of a seawall similar is to occur prior to new titles being created out of any approved subdivision application for the structure plan area. Funding and ongoing maintenance of the seawall would be undertaken by the developer in collaboration with other stakeholders (including PTA, ARC Infrastructure and Main Roads Western Australia). However, there will be allowance for subdivision and development to occur over Lots 1 and 2 should the Vancouver Peninsular isthmus be protected as a result of the City of Albany's CHRMAP process, as protection of the isthmus would mean that these lots and adjoining roads would be located outside of the 100 year horizon for erosion impact.

With respect to inundation hazards, the proposed approach would be to fill the proposed development sites to an elevation of at least 2.5 mAHD to avoid inundation risks

10. References

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11. Appendices

Appendix A **Erosion Hazard Lines**

Appendix B **Inundation Hazard Lines**

Appendix C **Development Concept Plan Draft (Rowe 2022)**

Appendix A Erosion Hazard Lines

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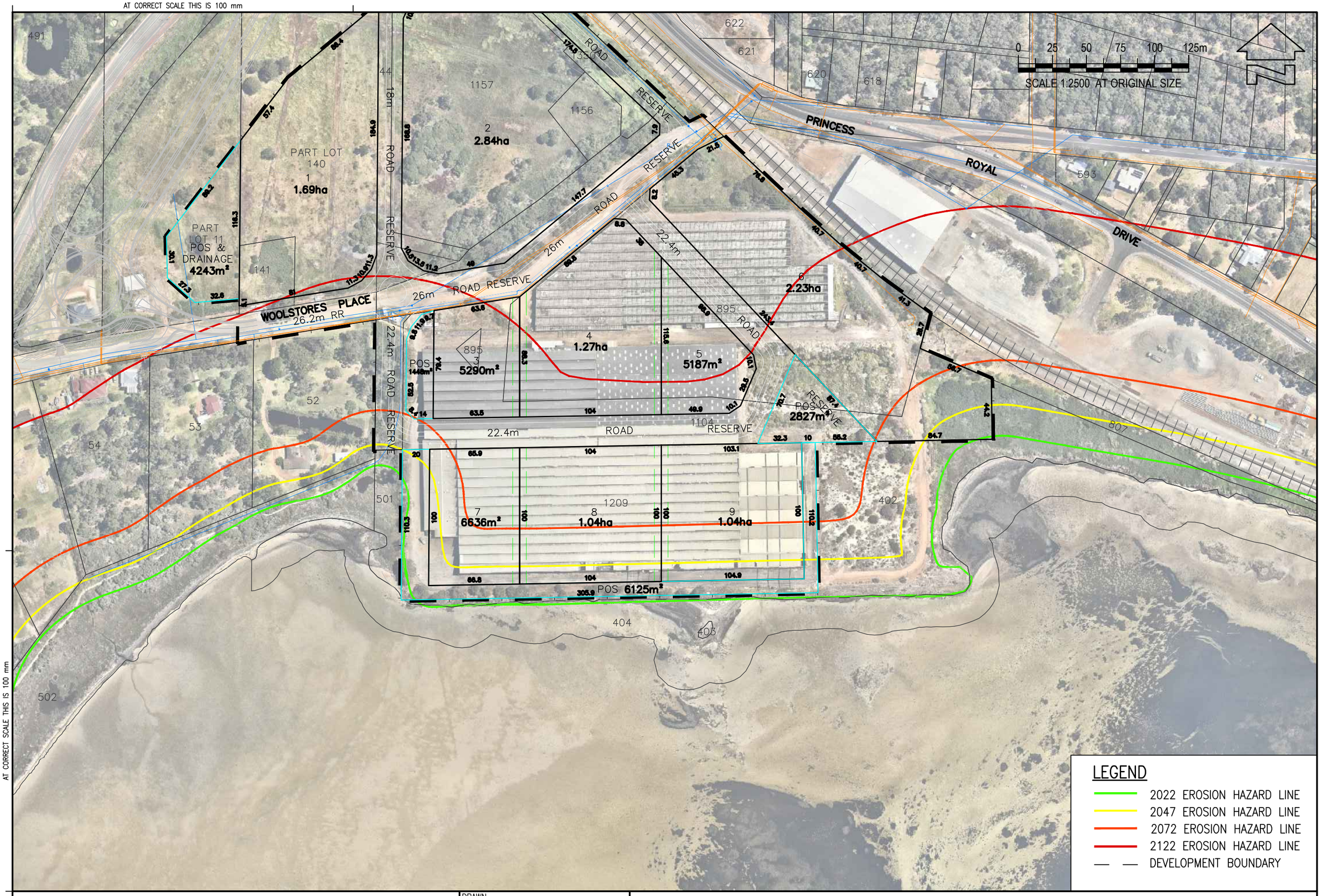

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Rowe – Albany Woolstores

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APRIL 2023

SK2027-01A

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Appendix B Inundation Hazard Lines

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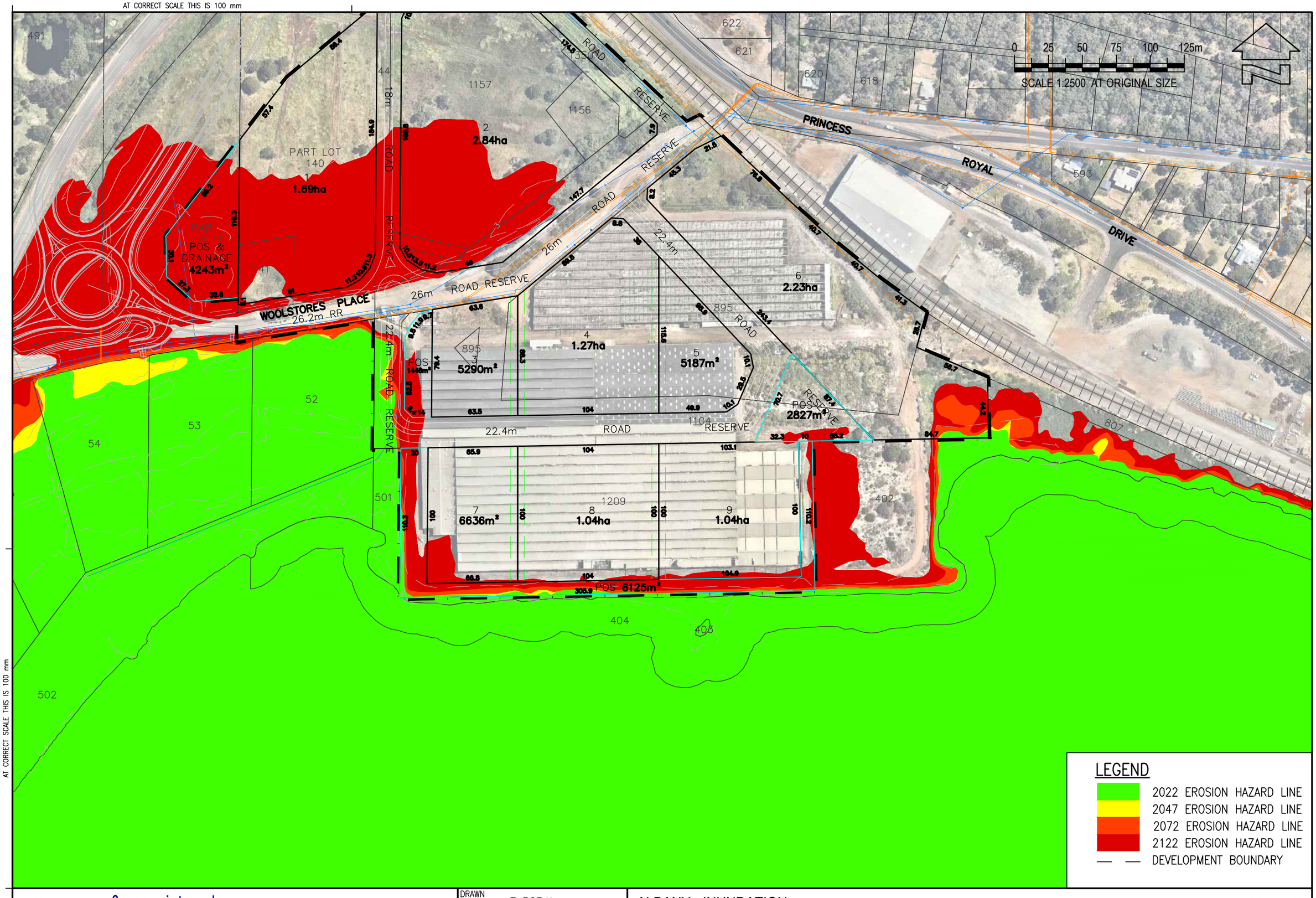

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Appendix C Development Concept Plan Draft (Rowe 2022)

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DEVELOPMENT CONCEPT

VARIOUS LOTS, WOOLSTORES PLACE
MOUNT ELPHINSTONE, ALBANY

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DRAWN:	VR
DATE CREATED:	2023.02.23
PROJECTION:	MGA50 GDA94
CADASTRE:	LANDGATE
SURVEY:	HARLEY DYKSTRA 23304-01A

ROWE GROUP DESIGN

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