

# City of Onkaparinga Coastal Adaptation Options Analysis

Progress Report | June 2023





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## TABLE OF CONTENTS

1.	INTRODUCTION .....	1
1.1	Purpose of this report.....	1
2.	BACKGROUND - COASTAL ADAPTATION STUDY .....	2
3.	COASTAL ADAPTATION CONCEPTS .....	3
3.1	Coastal adaptation and coastal management.....	3
3.2	Adaptive management model for coastal adaptation .....	3
3.3	Coastal adaptation options.....	4
3.4	Coastal adaptation responses.....	5
3.5	Incremental and Transformational Adaptation approaches.....	6
4.	METHODOLOGY.....	7
4.1	First pass assessment.....	7
4.2	Second pass assessment .....	9
5.	OUTCOMES OF ADAPTATION OPTIONS ANALYSIS .....	10
5.1	Related issues .....	11
6.	NEXT STEPS.....	17
	APPENDIX A: ADAPTATION OPTION ANALYSIS OUTCOMES BY CELL .....	18



## 1. INTRODUCTION

The City of Onkaparinga (Onkaparinga) has a long history of proactively managing changes in its coastline. In 2021, a Coastal Adaptation Study<sup>1</sup> was prepared to bring together all previously undertaken studies about the coast, provide a baseline understanding of how the coast operates and assesses the coastal risks and vulnerabilities from sea level rise.

The Coastal Adaptation Study shows how people, the natural environment, and built assets might be impacted by rising sea levels and other coastal changes, so that council and other stakeholders, such as state government and private landowners, can plan now for any future changes. In recognition that the coast varies from place to place, the study splits Onkaparinga's coastline into distinct regions or "cells".

Earlier this year, the City of Onkaparinga started the process of preparing its Coastal Adaptation Plan to provide a planned response to the recommendations of the Coastal Adaptation Study. Consultants BRM Advisory and Integrated Coasts are supporting Onkaparinga with this project.

A key part of the project is to screen, filter, evaluate and prioritise adaptation options that respond to the risks identified in the initial Coastal Adaptation Study.

In the month of April 2023, the project team:

- Designed a first pass assessment tool to stream and filter coastal cells (or minor cells) into a 'monitoring' or 'further evaluation' category based on the level of risk and related factors.
- Designed a second pass assessment tool to further evaluate adaptation options for coastal cells (or minor cells) that were identified as requiring further evaluation as a result of the first pass assessment.
- Conducted workshops on 21 and 28 April 2023 where each of these assessment processes were discussed and validated.

The Coastal Adaptation Options Analysis remains a work in progress until the adaptation proposals have been finalised, which will not occur until there is further engagement with the City of Onkaparinga Director Group and Elected Members, and broader community.

### 1.1 Purpose of this report

The purpose of this report is to provide a background to the coastal adaptation options analysis, document the methodology and outcomes, and describe how this information will be used in the next stage of the project.

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<sup>1</sup> <https://yoursay.onkaparinga.sa.gov.au/coastal-adaptation-study>



## 2. BACKGROUND - COASTAL ADAPTATION STUDY

The City of Onkaparinga Coastal Adaptation Study completed in 2021 provides the context for evaluating the adaptation options.

The study developed risk assessments that evaluated current and future risk to public assets, private assets, safety of people and potential disruption to ecosystems. In this study, the coastline of City of Onkaparinga was divided into twelve main coastal cells according to their coastal characteristics, with the larger cells divided further into minor cells.

The key findings from the study included:

- The coastline has been **largely stable** over a 70-year period (2-4m recession overall in some southern areas).
- The coastline undergoes **cycles of accretion and erosion** that take place over decades, which are now better understood.
- The predominant hazard is **erosion** because much of City of Onkaparinga is set within elevated locations.
- Of the four hazard impact categories, the main threat is to **public assets** because most **private assets** are set behind public roads.
- The timing of the threat to these assets varies but will primarily be related to **sea level rise** that is projected to occur in the future.
- There are '**hotspot**' **locations** (Snapper Point at Aldinga, Seaford Cliffs) and more will emerge due to ongoing coastal processes which will be exacerbated by sea level rise.

Since the completion of the Coastal Adaptation Study in 2021, two studies have been released that provide further context to consider how these local findings relate to what is happening in other Australian coastal areas.

Professor Andrew Short (2022) evaluated Australian beach systems using satellite photography<sup>2</sup>, and he found that over the last 40 years, 78% of Australian beaches were stable, 11% were receding, and 11% were accreting.

Dr Phil Watson (2020) evaluated four long term tide gauges around Australia, including Outer Harbor with a focus on identifying longer term sea level rise signals, and found only weak acceleration in the rate of sea level rise for two of these gauges.

From this brief review, it would appear that the findings from the City of Onkaparinga's Coastal Adaptation Study are consistent with recent research of the overall Australian coastal context.

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<sup>2</sup> DEA Coastlines, satellite photography.



### 3. COASTAL ADAPTATION CONCEPTS

#### 3.1 Coastal adaptation and coastal management

In the context of the climate, 'adaptation' is defined by the Intergovernmental Panel on Climate Change as 'the process of adjustment to actual or expected climate and its effects'<sup>3</sup>.

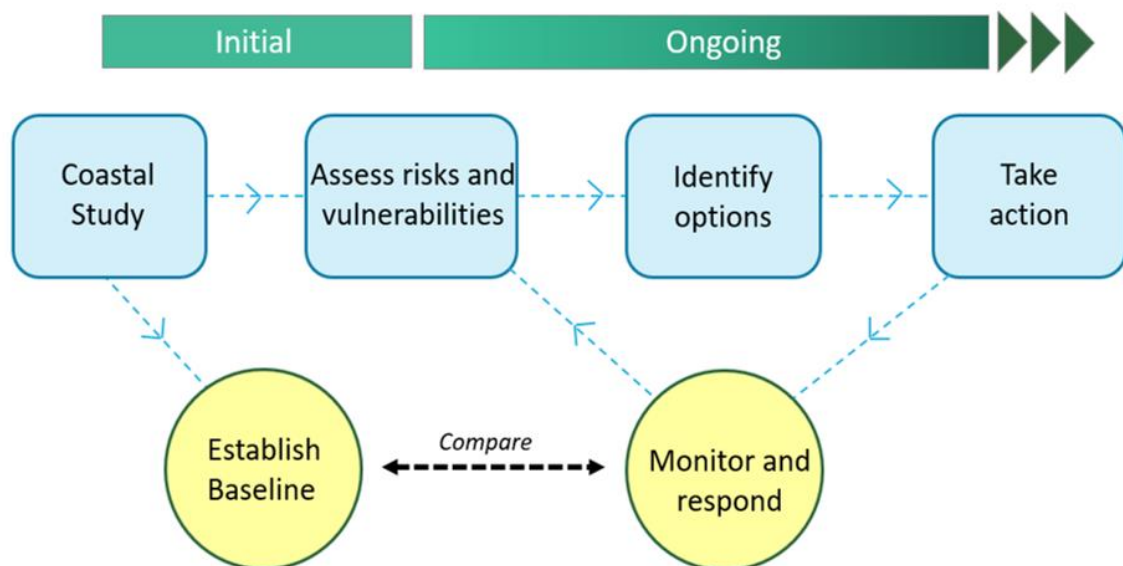
Coastal management is a wider concept which relates to general management practices in the coastal system such as managing foot traffic, weed control, and dune stabilisation, whereas coastal adaptation includes the idea of 'adjustment' that may be required, usually within urban settings.

Coastal management techniques are often used as adaptation options to adjust to the impact of coastal processes, especially when seas rise. When engaging communities around coastal adaptation, coastal management issues will inevitably arise as this is how coastal adaptation is most readily seen and understood in the community.

#### 3.2 Adaptive management model for coastal adaptation

The model of coastal adaptation adopted for Onkaparinga through its Coastal Adaptation Study is known as adaptive management. 'Adaptive management' is defined as an intentional approach to making decisions and adjustments in response to new information or changes in context'<sup>4</sup> and is illustrated in Figure One.

**Figure One: the Adaptive Management approach to coastal adaptation.**



Mark Western (2017)

<sup>3</sup> IPCC, 2014

<sup>4</sup> USAID, Learning Lab





This adaptive management model is being applied by the City of Onkaparinga as follows:

- The Coastal Adaptation Study in 2021 assessed the risks and vulnerabilities for each coastal cell (or minor cell). Two processes were used in risk assessment – one process evaluated the inherent coastal hazard risk which contextualises the risk within the South Australian coastal setting, and the second utilised the risk management framework of City of Onkaparinga.
- The Coastal Adaptation Study also established a baseline understanding of how the coastline has been operating over the last 50-70 years. This study included an analysis of aerial and land-based photography, historical storm impacts, and in particular the location of the shoreline.
- In the context of this model of adaptive management and a largely stable coastline, the key response will be to conduct monitoring to identify changes that may occur to the coast when compared to the baseline established in Coastal Adaptation Study. The findings from ongoing monitoring will provide the evidence base from which to 'make decisions and adjustments'<sup>5</sup>. A coastal monitoring plan for City of Onkaparinga will be developed later in this project.
- The arrows that circulate around the 'ongoing' section of the diagram indicate that coastal adaptation will be an ongoing process for years, decades, and possibly even centuries, especially if seas rise as projected.
- The Coastal Adaptation Study also identified cells (or minor cells) that were at higher risk now, or will be in the near future, and in these locations, there is a need to 'identify options' now to inform coastal adaptation action.

In summary, in this project we are drawing upon the risk assessments from the Coastal Adaptation Study to identify suitable adaptation options for areas of the coast that require more attention than ongoing monitoring.

### 3.3 Coastal adaptation options

Taking into account the findings of the Coastal Adaptation Study and in particular the risk assessment for each cell or minor cell, the goal of the adaptation option analysis is to consider the full range of options to manage coastal adaptation relative to the risks identified.

Adaptation options are usually grouped within the following main categories:

**Hold the line** – Install protection infrastructure that reduces the impact of coastal hazards or use environmental practices to strengthen natural protective forms such as dunes.

**Managed retreat** – progressively move assets or services away from areas that could be impacted by coastal hazards now or in the future.

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<sup>5</sup> USAID, Learning Lab



**Accommodate** – accept some degree of hazard and conduct limited intervention to manage the hazard.

**Defer and monitor** – the threat to infrastructure or services is identified but the realisation of the threat will most likely be dependent on seas rising as projected.

**Loss acceptance** – accept that coastal hazards will cause negative impacts on assets and services and when this occurs, they will not be replaced.

One further response that has been utilised more extensively in other countries is known as 'advance' or 'attack'. This approach involves land reclamation where material is pushed into the sea to create more land, or a levee or bund is created around an area of land which is subsequently drained and made usable for urban use. These techniques have been used in places such as Singapore and the Netherlands.

### 3.4 Coastal Adaptation responses

Within five of the six response categories, there is a range of potential adaptation options in the areas of:

- Planning
- Engineering
- Environmental management
- Social, community and education measures.

Each of the following responses has positive and negative attributes, and the suitability of each response type will depend upon the location, the risks evident and a range of social and environmental factors. It is not uncommon to utilise a range of adaptation responses in coastal adaptation over time.

#### Planning

Planning responses use land use planning instruments to reduce vulnerability and increase resilience to climate change and sea-level rise. Thus, land that is projected to become more prone to coastal inundation in the future can be zoned for less intensive or less permanent uses.

#### Engineering

In the context of coastal adaptation, engineering has come to describe capital works strategies such as seawalls and levees. Such projects are 'engineered' to solve a particular challenge such as to protect coastal infrastructure or other assets from erosion and inundation damage. These approaches differ from other responses in that they require significant commitments of financial and social resources and create and then maintain a physical asset.

#### Environmental management

Environmental management refers to nature-based solutions such as the revegetation of coastal dunes or building structures to support continued growth of coastal habitats such as





seagrasses or reefs. It may also include developing artificial reefs to reduce wave erosion of shorelines or engineered solutions to prevent encroachment of saltwater into freshwater systems.

### **Social, community and education measures.**

Social, community and education measures aim to engage communities around the management of coastal change. Strong and successful engagement throughout all stages of an adaptation project — development, implementation and evaluation— can make the difference between success and failure. Engagement can build success by ensuring that communities are:

- informed – they are fully aware of the risks being addressed, the planned action, and the expected outcomes.
- supportive – having fully understood the adaptation option under consideration, the pros and the cons, they are supportive of it.
- contributing – where there are opportunities, communities can make a positive contribution, for example, by engaging in citizen science projects to collect data for monitoring and evaluation purposes.

### **3.5 Incremental and Transformational Adaptation approaches**

There are two broad ways in which adaptation can occur in relation to timing.

The **incremental** approach to coastal adaptation is a series of relatively small actions and adjustments aimed at continuing to meet the existing goals and expectations of the community in the face of the impacts of climate change. This is the more common approach and generally aims to preserve community values around what is important.

In some locations, however, incremental changes will not be sufficient. The risks created by climate change may be so significant that they can only be addressed through more substantial action.

**Transformational** adaptation involves a paradigm shift: a system-wide change with a focus on the longer term. For example, a proposed foreshore redevelopment may be an occasion where an alternative vision could be adopted, such as establishing a shared use zone to create greater buffer between actions of the sea and coastal infrastructure.

In most instances, the incremental approach is appropriate in the context of the existing and future rates of sea level rise. However, in some higher risk locations it may be a worthwhile exercise to take a 'take a few steps back' and consider alternative urban layouts and coastal adaptation strategies.



## 4. METHODOLOGY

The project developed a two-staged methodology that aimed to:

1. Validate and confirm that detailed options analysis was not required in lower risk locations with the understanding that ongoing monitoring will provide an early warning of potential or emerging 'problem spots'; and
2. Evaluate the adaptation options in locations where there is a higher level of current or future risk; and/or stakeholders identified that additional options should be considered at this point in time.

In support of these goals, the project team adopted a methodology involving a 'first pass' and 'second pass' evaluation of coastal adaptation options.

### 4.1 First pass assessment

The first pass assessment streamed cells (or minor cells) into one of three categories:

- A **general monitoring** category where it was deemed that no immediate action or further investigation was necessary (and that Onkaparinga's future active coastal monitoring will provide an early warning of coastal change that may change the understanding of current and future risk).
- A **defer and monitor** category where specific risk items are identified in the context of sea level rise projections, or where 'further investigation' is required about a particular coastal issue. In these sites, the 'defer' refers to the fact that the adaptation option analysis is being deferred until such time as the coastal monitoring indicates that sea levels have risen, and the risk may become material.
- A **further evaluation** to the second pass assessment to consider additional adaptation options for locations with a higher level of current or future risk.

Initially, the first pass assessment considered the inherent nature of the coastline, the proximity of infrastructure, and the likely timeframe until impacts were likely to be experienced upon the coast when taking into account projected sea level rise.

An assessment process was devised to provide a quantitative rating to indicate which of the above three categories was likely to apply (Table One). This numerical ranking was based on the risk assessment outcomes for the cell as documented in the Coastal Adaptation Study.



**Table One: Quantitative – Inputs from the risk assessment**

		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	7	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	2	
	Public assets (2100)	0	1	2	3	4	4	
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	0	
4	Decades until likely impact (reverse order)	0	2	4	6	8	6	
		5 decades	4 decades	3 decades	2 decades	1 decades	19	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

During the analysis workshop, there was an opportunity for participants to overlay the quantitative assessment with other relevant coastal factors that may alter the final recommendation. Table Two shows an example of the qualitative factors considered.

**Table Two: Qualitative – review of additional coastal factors.**

	Do any of the following change the options outlook?									Comment
5	Public safety risk assessment	0	1	2	3	4	Y	N		Assessed by GHD, 2016
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N		Possible sediment impact to reef.
7	Are there any storm water issues that should be considered						Y	N		
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N		If seas rise as projected, sea level rise will impact
9	Are there any stakeholder interests that would indicate further investigation?						Y	N		cliff stability and infrastructure adjacent cliff top.
10	Are there any other factors that suggest further investigation required?						Y	N		
	<b>Recommendation</b>									<b>Explanation (if required)</b>
	Assign to 'general monitoring' with no current issues.									Monitor cliff base and cliff crests in locations where
	Assign to 'defer and monitor' and/or 'further investigation'.						X			infrastructure is placed within close proximity to
	Refer for further analysis and/or action (see next page).									cliff crest.

In some locations, it was recognised that if seas rose in line with projections, a specific threat to infrastructure would likely occur, and if this occurred, then an adaptation decision would be required in the future. These locations were assessed as 'defer and monitor' and will be brought into the monitoring program with a specific monitoring focus and higher level of scrutiny. The 'defer' component, thus, relates to deferring the adaptation options analysis until such a time as the monitoring reveals that the anticipated future risk is becoming a reality due to sea level rise.

In some cells (or minor cells), coastal issues were identified that either required further research or additional action was recommended.



## 4.2 Second pass assessment

Coastal cells (or minor cells) from which the first pass assessment identified the need for further options analysis were evaluated in a second pass assessment to identify the most appropriate option. A more comprehensive review was undertaken of the location and the following considered:

- The preferred adaptation option – hold the line, managed retreat, accommodate or loss acceptance.
- A likely adaptation response – planning, environmental, engineering.
- Whether an incremental or transformative approach should be applied.

The second pass assessment also reviewed existing projects and plans for locations where Onkaparinga has already begun the adaptation process. Figure Two provides an example of a second pass assessment worksheet.

**Figure Two: Second pass assessment worksheet.**

<b>1 Identify previous adaptation actions. Why are additional actions likely to be required?</b>				
Rock protection installed on northern end (1973-1975). Further rock protection installed 1981-1985, and upper slopes filled and stabilised. Upper cliff stabilisation 2000-2003. Storms in 2003 damaged revetment, likely in the original section installed in 1970s (repaired). Studies in 2009 and 2011 analysed the initial protection installed in 1970s as 'extremely variable'. The height of the seawall appears adequate to 2050 (using CES higher water levels) but report indicates vulnerable 1:50.				
<b>2 Identify possible options</b>	Unlikely	Possible	Likely	<b>Justify or explain the response</b>
Hold the line (engineering or environmental)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Assuming reports are accurate - rock revetment requires upgrade.
Managed retreat (move assets/services away from coast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	The decision to protect was made in the 1970s.
Accommodate (make minor adjustments, accept some risk)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No obvious ways accommodation can be utilised.
Loss acceptance (do nothing)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not acceptable - public road, tourist route, services housing.
<b>3 Taking into account the preferred option(s) consider responses</b>				
Planning	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	The area is coastal reserve, public road. Housing set well back behind esplanade rd.
Engineering	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Upgrade rock revetment is only choice.
Environmental	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not suitable- deeper water at base of rock revetment.
<b>4 Could the community make a contribution?</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Rock revetment is main solution. Maintain vegetation in cliffs (not viable for comm.)
<b>5 Should a transformative approach be considered?</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The decision to protect was made in the 1970s.
<b>6 Conclusion (2nd Pass)</b>				
The scenario modelling indicates the current height of the walling is adequate to manage storm events to sea level rise projected for 2050 (using CES increased levels in context of sea walls). Analysis by CES in 2011 indicated that seawall is less likely to be vulnerable to undermining (but investigations required), more likely to be vulnerable to overtopping in 1 in 50 year event. Council advises that walling is degenerating and therefore likely to require upgrade.				



## 5. OUTCOMES OF ADAPTATION OPTIONS ANALYSIS

Table Three summarises the results of the preliminary adaptation options analysis.

The first column (green) contains locations that require no further analysis at this stage, and will be actively monitored over time.

The middle column (yellow) contains locations that do not require any further adaptation analysis, and will also be actively monitored, but where further investigation was required, or a specific monitoring focus was desirable (rather than general monitoring).

The third column (red) contains locations where additional adaptation option analysis was completed.

This is followed by a map that shows the same information graphically (Figure Four). Table Four then details the sites that require further investigation and/or a specific monitoring focus (the 'yellow' column), while Table Five documents the possible and preferred adaptation options from the preliminary adaptation options analysis from sites in the 'red' column.

The detailed results for each cell are provided in Appendix A.



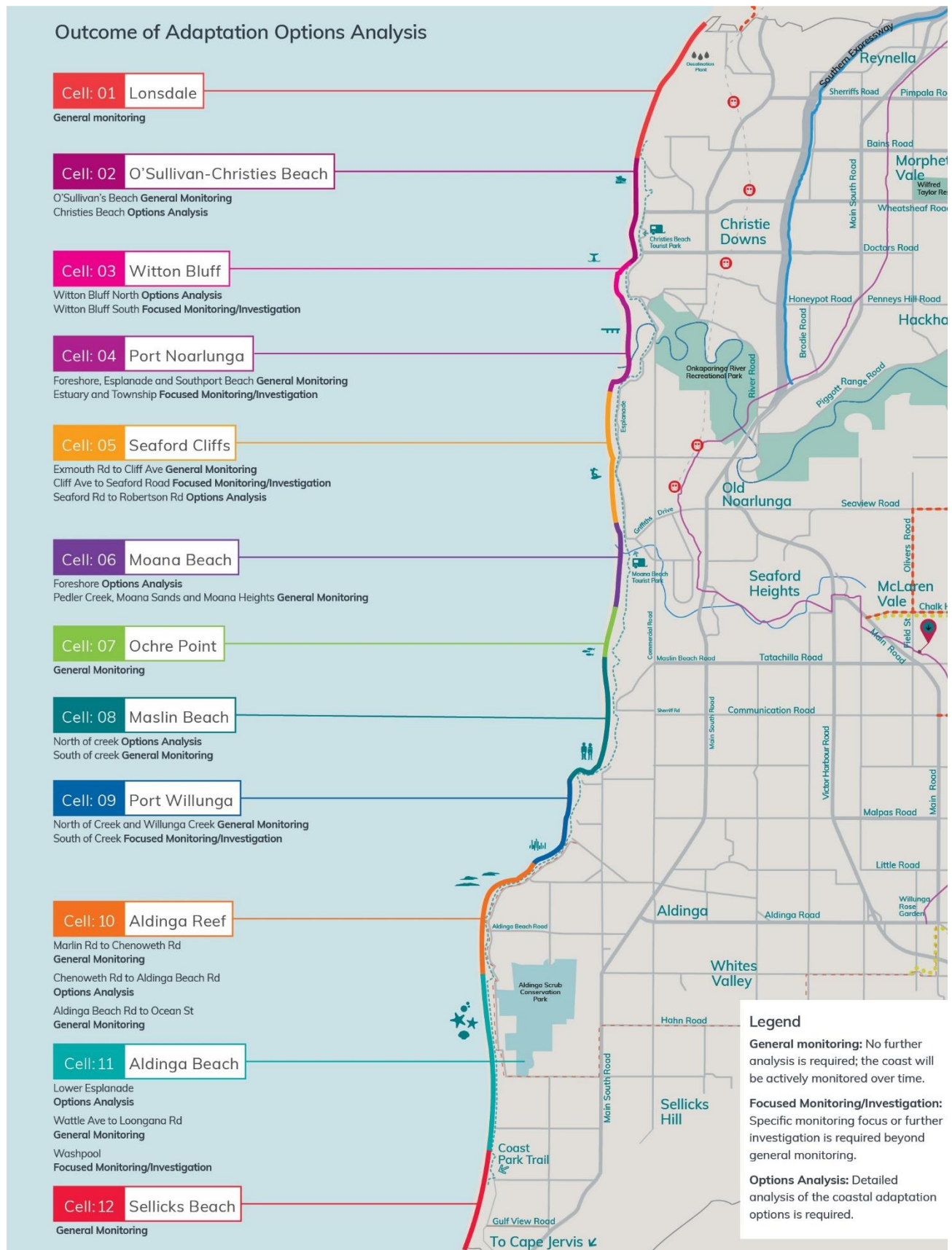
**Table Three: Summary of Coastal Adaptation Option Analysis**

Cell	Cell Name	Minor Cell	Monitor (General)	Monitor (Investigate)	Options Analysis
1.0	Lonsdale	NA	X		
2.1	Christies-O'Sullivan	O'Sullivan Beach	X		
2.2	Christies-O'Sullivan	Christies Beach			X
3.1	Witton Bluff	North - rock protected			X
3.2	Witton Bluff	South - no protection		X	
4.1	Port Noarlunga	Foreshore	X		
4.2	Port Noarlunga	Esplanade	X		
4.3A	Port Noarlunga	Southport Beach	X		
4.3B	Port Noarlunga	Onka Estuary		X	
4.4	Port Noarlunga	Township		X	X
5.1	Seaford Cliffs	Exmouth Rd to Cliff Ave	X		
5.2	Seaford Cliffs	Cliff Ave to Seaford Rd		X	
5.3	Seaford Cliffs	Seaford to Robertson Rd			X
6.1	Moana Beach	Foreshore			X
6.2	Moana Beach	Pedler Creek		X	
6.3	Moana Beach	Moana Sands Conserv.	X		
6.4	Moana Beach	Moana Heights	X		
7.0	Ochre Point	NA	X		
8.1	Maslin Beach	North of Maslin Creek		X	X
8.2	Maslin Beach	South of Maslin Creek	X		
9.1	Port Willunga	North of Willunga Creek	X		
9.2	Port Willunga	Willunga Creek	X		
9.3	Port Willunga	South of Willunga Creek		X	
10.1	Aldinga Reef	Marlin to Chenoweth	X		
10.2	Aldinga Reef	Chenoweth to Aldinga Bch Rd			X
10.3	Aldinga Reef	Aldinga Bch Rd to Ocean St	X		
11.1	Aldinga Beach	Lower Esplanade			X
11.2	Aldinga Beach	Wattle to Loongana	X		
11.3	Aldinga Beach	Washpool		X	
12.0	Sellicks Beach	NA	X		





**Figure Four: Summary of Coastal Adaptation Option Analysis**





**Table Four: Sites that require further investigation and/or a specific monitoring focus as identified through the first pass assessment.**

Cell	Name	Location	Issue
3.2	Witton Bluff	South (below Esplanade Road)	Monitor erosion impact from any sea level rise to the soft limestone cliff under the Esplanade.
4.3B	Port Noarlunga	Last bend in the river	Review and update the previous investigation (2016) into the condition of the cliffs at the last bend in river.
4.4	Port Noarlunga	River Road/ levee and embankments	Investigate possible flood vulnerability to River Road. Review adequacy of embankment and levee heights from sea water inundation projected after 2050.
5.2	Seaford Cliffs	Seaford Beach	Monitor erosion impact from any sea level rise to the base of cliffs in locations where infrastructure is placed at the top of the cliffs.
6.2	Moana Beach	Pedler Creek	The caravan park and Nashwauk Terrace are unlikely to be currently at risk from sea storms. Investigate the height of the levees and embankments and seawater intrusion through storm water pipes.
8.1	Maslin Beach	North – old sand mine site.	Monitor interactions of the sea with former sand mine embankment as a result of any sea level rise.
9.3	Port Willunga	Star of Greece	A study in 2006 identified the eroding gully under the Star of Greece. Monitor and investigate to establish if there are likely to be any ongoing concerns.
11.3	Aldinga Beach	Washpool	Investigate the impact of any sea level rise on the pebble bank. A preliminary study was conducted in 2021 that was unable to establish whether increases in sea level would cause the pebble bank to recede or whether it would erode away. Further investigation may be warranted.



**Table Five: Adaptation Options reviewed through the second pass assessment**

Cell	Name	Location	Possible adaptation options	Preferred adaptation option
2.2	Christies Beach	Main beach	Hold the line. Retreat the foreshore.	Hold the line – progressively upgrade and maintain rock revetment to manage sea flood height projected for 2050. Consider not installing the additional rock revetment to the north and consider environmental based solutions (i.e sand dune creation).
3.1	Witton Bluff	North – old rock revetment section.	Hold the line. This decision was established in the 1970s and 1980s.	Hold the line – progressively upgrade and maintain rock revetment which is at the end of its design life, vulnerable to overtopping and damage in 1 in 50 year events, and will be increasingly vulnerable to sea level rise.
4.4	Port Noarlunga Township	Saltfleet Street	Hold the line to protect against flooding.  Accommodate by allowing rare flooding events to overtop.	Hold the line – Install protection structure on western side of Saltfleet Street as part of the Wearing Street upgrade project.  Investigate the potential to raise the embankments and levees around Jubilee playground.
5.3a	Seaford Cliffs	In vicinity of Gulf St	Hold the line. Protect the base of the cliff and/or top of the cliff.  Managed retreat. Reduce width of road reserve, divert or reduce traffic.	Hold the line – this strategy is likely to include retaining and protection items at the top and the bottom of the cliff to progressively manage erosion issues as they arise.  Installation of cliff top retaining structures are currently in progress (Esplanade - opposite Gulf Street).
5.3b	Seaford Cliffs	Tiller Drive	Retreat carpark and shared path infrastructure.	This retreat work is currently in progress.
5.3b	Seaford Cliffs	Walking trail – Tiller Drive to Robertson Road	Hold the line. Protect the base of the cliff.  Retreat the walking trail.	Create masterplan for the foreshore area that relocates the walking trail further away from the cliff top. Progressively install as the current walking trail reaches the end of its design life or if the cliff top recession impacts upon the path.



Cell	Name	Location	Possible adaptation options	Preferred adaptation option
6.1	Moana	Moana SLSC	Hold the line. Retreat. Build new SLSC. Accommodate. Allow infrequent impact, install modifications.	Accommodate - as impacts are minor and infrequent. Modify stairs and ramp in front of SLSC to prevent overtopping and wave runup. Install modifications to the base of the SLSC to manage infrequent storm wave runup (if required). Hold the line with environmental based solutions (i.e. creating sand dune buffer) to reduce frequency of inundation.
6.1	Moana	Moana foreshore	Hold the line. Retreat the infrastructure. Accommodate overtopping.	At the time when foreshore renewal is contemplated, create a master plan that incorporates some or all of these options. Hold the line - environmental solutions (i.e. creating sand dune buffer) to reduce frequency of inundation.
8.1	Maslin Beach	Maslin Creek carpark	Hold the line. Retreat carpark infrastructure.	Managed retreat – when carpark requires upgrade, consider reducing the carpark size to allow the coast to progressively retreat.
10.2	Aldinga Reef	Snapper Point	Hold the line. Retreat road infrastructure through diversion or reducing traffic.	Hold the line – offshore rock revetment (bund) proposed to be offset from the cliff as a buffer against actions of the sea.
11.1	Aldinga Beach	Lower Esplanade	Hold the line. Retreat. Remove road infrastructure.	Hold the line – environmental based response via the establishment of the sand dune through sand drift fencing and vegetation (conduct trials).

## 5.1 Related issues

It should also be noted that the adaptation options analysis process identified a wide range of broader issues that will need to be considered in the ongoing management of the coast.

While these issues did not directly speak to the cell-by-cell adaptation options analysis, they have some relevance to the overall coastal adaptation plan and coastal management more generally. These issues include:

- Managing the impacts of population growth on beach access and use.



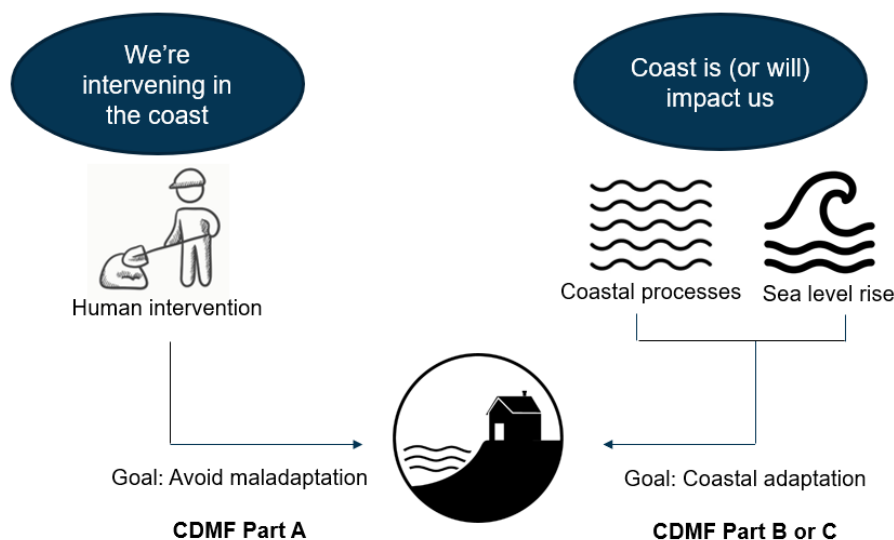
- The many sites of cultural significance to First Nations within the City of Onkaparinga's coastal zone, and the need to better understand the extent to which these should be protected from the impacts of coastal change.
- Community values around access to sandy beaches and vehicle use on the beach.
- Tourism and other economic values associated with the coast.
- Preserving and strengthening coastal biodiversity.
- Safety risks.

It is expected that these issues – and others – will arise through the community engagement process for this project. This will deepen Onkaparinga's understanding of community values as they relate to the coast, and provide additional context for the Coastal Adaptation Plan.

It should be noted, however, that the Coastal Adaptation Plan may not be the most appropriate mechanism to address all of these coastal management issues, and other approaches may provide a pathway for action in the short to medium term.

It should also be noted that a Coastal Decision Making Framework (CDMF) is being developed as a separate output of this project. This framework will provide guidance for council officers and decisions makers to proactively consider coastal adaptation when undertaking broader activities within the coastal system. The framework provides decision tools that address new interventions in the coast, as well as immediate coastal hazards, and formal adaptation option analysis (Figure Five).

**Figure Five: Onkaparinga's draft Coastal Decision Making Framework**





## 6. NEXT STEPS

Having undertaken the preliminary coastal adaptation options analysis, the next steps of the project are to move into an engagement phase.

Consultation will be undertaken with Onkaparinga's Director group and Elected Members before commencing a comprehensive community engagement process informed by the Community Engagement Plan for this project (approved by the previous Council in October 2022).

The goals of the upcoming engagement process are to:

1. Provide stakeholders and community members with information about the project that is:
  - Readily accessible
  - Easily understood
  - Does not cause unnecessary concern.
2. Provide stakeholders and community members with multiple avenues for open, inclusive, transparent and meaningful engagement.
3. Support stakeholders and community members to understand the way our coast operates, the current and future risks posed by sea level rise, and options being considered for managing coastal adaptation.
4. Gain feedback from the stakeholders and the community about their values and priorities for coastal management in the context of sea level rise and the proposed adaptation options.

Following this engagement, the adaptation options for each cell will be updated and inform the development of Onkaparinga's Coastal Adaptation Plan and Monitoring Program.

It is envisaged that the Coastal Adaptation Plan will outline council's principles and strategic priorities for managing coastal change, and the approach to coastal adaptation. It will also detail the specific, cell-by-cell coastal adaptation actions that respond to the adaptation options analysis.

The Monitoring Program will outline the general approaches to coastal monitoring to support the Adaptation Plan, as well as the specific monitoring required as key sites, as identified through the adaptation options analysis process.

There will be a further round of consultation to seek feedback on the draft documents before they are finalised.





**APPENDIX A: ADAPTATION OPTION ANALYSIS OUTCOMES BY CELL**

## Lonsdale Region

### Options Analysis (First Pass)

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

## Cell 1.0

### Lonsdale region

Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	2	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	1	
	Public assets (2100)	0	1	2	3	4	2	
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	0	
4	Decades until likely impact (reverse order)	0	2	4	6	8	4	
		5 decades	4 decades	3 decades	2 decades	1 decades	9	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

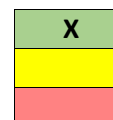
								Comment	
5	Public safety risk assessment	0	1	2	3	4	Y	N	Path has been raised.
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	One outlet in poor repair
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'active monitoring' with no current issues.

Assign to 'defer and monitor' and/or 'further investigation'.

Refer for further analysis and/or action (see next page).



### Explanation (if required)

Assign to general monitoring.

## Christies-O'Sullivan

## Cell 2.1

### Options Analysis (First Pass)

### O'Sullivan Beach

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	5	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	0	
	Public assets (2100)	0	1	2	3	4	2	
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	0	
4	Decades until likely impact (reverse order)	0	2	4	6	8	4	
		5 decades	4 decades	3 decades	2 decades	1 decades	11	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

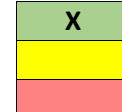
								Comment	
5	Public safety risk assessment	0	1	2	3	4	Y	N	
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.

Assign to 'defer and monitor' and/or 'further investigation'.

Refer for further analysis and/or action (see next page).



### Explanation (if required)

Assign to general monitoring.

## Christies-O'Sullivan

## Cell 2.2

### Options Analysis (First Pass)

### Christies Beach

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

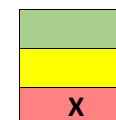
Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	4	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	2	
	Public assets (2100)	0	1	2	3	4	4	
3	Private assets (2020)	0	1	2	3	4	1	
	Private assets (2100)	0	1	2	3	4	3	
4	Decades until likely impact (reverse order)	0	2	4	6	8	8	Vulnerable in 1 in 100-year current
		5 decades	4 decades	3 decades	2 decades	1 decades	22	Score 18 or less - assign to monitoring. Score 19 to 20 - consider further evaluation. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

								Comment	
5	Public safety risk assessment	0	1	2	3	4	Y	N	
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	Public assets at risk if seas rise as projected.
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	Prominent foreshore precinct.
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).



### Explanation (if required)

SEE NEXT PAGE

# Christies-O'Sullivan

## Cell 2.2

### Options Analysis (Second Pass)

#### Christies Beach

This purpose of this worksheet is to analyse cells (or minor cells) that have been assessed as likely requiring adaptation action now or in the near future (5 years). The suitability of broad adaptation options are considered first, these being, managed retreat, hold the line, accommodate, loss acceptance (also known as 'do nothing'). Within these options are responses for consideration such as planning, engineered, environmental, or community responses.

#### 1 Identify previous adaptation actions. Why are additional actions likely to be required?

Former vertical clay cliffs modified to slopes early 1970s (toe of cliff moved seaward 7-10m). O'Sullivan Beach boat ramp installed 1980. Sand monitoring 1994-1997 (in time of erosion). Studies 2009, 2011. Groyne installed at yacht club (N.D.). Caton, CES warned of beach loss (no beach by 2030) but beach levels at 2020 were higher than 1970s. Recommendation for sand nourishment is monitored by CPB profile surveys. Seawalls were deemed deficient for current 2020. Recommend raise to 2050 or 2100.

#### 2 Identify possible options

Hold the line (engineering or environmental)

Unlikely

☐

Possible

☐

Likely

☒

#### Justify or explain the response

Upgrade, replace rock revetment. In context of slow SLR, recommend 2050 risk.

Managed retreat (move assets/services away from coast)

☒☐☐

Retreat half road, retreat toe/ slope (increase buffer 9m). Cost prohibitive.

Accommodate (make minor adjustments, accept some risk)

☒☐☐

No obvious ways accommodation can be utilised.

Loss acceptance (do nothing)

☒☐☐

Not acceptable - public road, tourist route, services housing.

#### 3 Taking into account the preferred option(s) consider responses

Planning

☒☐☐

The area is coastal reserve, public road. Housing set well back behind esplanade rd.

Engineering

☐☐☒

Rock revetment is likely choice - base of the slope (risk 2050).

Environmental

☒☐☐

Any attempt at base would be quickly removed by actions of the sea.

#### 4 Could the community make a contribution?

☒☐☐

Unlikely - but in 1990s, citizens (clubs) conducted sand monitoring,

#### 5 Should a transformative approach be considered?

☐☒☐

Possible to envision pedestrian/ vehicle one way promenade but cost is likely to be prohibitive and unlikely to achieve community approval..

#### 6 Conclusion (2nd Pass)

The risk assessment indicates that the seawall is either low in places or deficient in structure. The decision to protect this coast was made in the 1970s and it is unlikely that alternative vision would be effective. Plans have been drawn up for seawall from Beach Road to Surf Club. Recommend - consider not implementing seawall to Christies Creek (subject to monitoring). Consider, review where the wall is low/inadequate provide interim protection rather than complete upgrade.

## Witton Bluff - North

## Cell 3.1

### Options Analysis (First Pass)

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

### Witton Bluff - rock revetment section

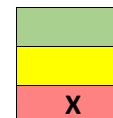
Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	4	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	1	
	Public assets (2100)	0	1	2	3	4	4	
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	3	
4	Decades until likely impact (reverse order)	0	2	4	6	8	6	Vulnerable in 1 in 100-year current
		5 decades	4 decades	3 decades	2 decades	1 decades	18	Score 18 or less - assign to monitoring. Score above 19 to 20 - consider further evaluation. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

Do any of the following change the options outlook?		No risk	Low	Medium	High	Very high	Y	N	Comment
5	Public safety risk assessment	0	1	2	3	4	Y	N	No additional risk - assuming walking trail is ok
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	Walling will require upgrading for 2050 risk.
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).



### Explanation (if required)

SEE NEXT PAGE



## Witton Bluff - North

## Cell 3.1

### Options Analysis (Second Pass)

### Witton Bluff - rock revetment section

This purpose of this worksheet is to analyse cells (or minor cells) that have been assessed as likely requiring adaptation action now or in the near future (5 years). The suitability of broad adaptation options are considered first, these being, managed retreat, hold the line, accommodate, loss acceptance (also known as 'do nothing'). Within these options are responses for consideration such as planning, engineered, environmental, or community responses.

#### 1 Identify previous adaptation actions. Why are additional actions likely to be required?

Rock protection installed on northern end (1973-1975). Further rock protection installed 1981-1985, and upper slopes filled and stabilised. Upper cliff stabilisation completed 2000-2003, revetment repositioned and rock added. Storms in 2003 damaged revetment, likely in the original section installed in 1970s (repaired). Studies in 2009 and 2011 analysed the protection installed in 1970s as 'extremely variable'. Seawall height appears adequate to 2050 (using CES higher water levels) but report indicates vulnerable to 1:50 event.

#### 2 Identify possible options

Hold the line (engineering or environmental)

Managed retreat (move assets/services away from coast)

Accommodate (make minor adjustments, accept some risk)

Loss acceptance (do nothing)

Unlikely	Possible	Likely	Justify or explain the response
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Assuming reports are accurate - rock revetment requires upgrade.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	The decision to protect was made in the 1970s.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No obvious ways accommodation can be utilised.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not acceptable - public road, tourist route, services housing.

#### 3 Taking into account the preferred option(s) consider responses

Planning

Engineering

Environmental

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	The area is coastal reserve, public road. Housing set well back behind esplanade rd.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Upgrade rock revetment is only choice.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not suitable- deeper water at base of rock revetment.

#### 4 Could the community make a contribution?

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Rock revetment is main solution. Maintain vegetation in cliffs (not viable for comm.)
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#### 5 Should a transformative approach be considered?

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The decision to protect was made in the 1970s.
--------------------------	-------------------------------------	--------------------------	--

#### 6 Conclusion (2nd Pass)

The scenario modelling indicates the current height of the walling is adequate to manage storm events to sea level rise projected for 2050 and further analysis by Water Technology in 2020 indicated the seawall is also likely to be vulnerable to overtopping and damage in 1 in 50 year event. Council advises that the northern sections of the 1975 built seawall is at the end of its 50 year design life and will require progressive maintenance and upgrade.

## Witton Bluff - South

## Cell 3.2

### Options Analysis (First Pass)

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

### Witton Bluff - no rock revetment

Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	5	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	1	
	Public assets (2100)	0	1	2	3	4	3	Soft cliff under Esplanade Road - possible erosion.
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	1	
4	Decades until likely impact (reverse order)	0	2	4	6	8	4	Vulnerable in 1 in 100-year current
		5 decades	4 decades	3 decades	2 decades	1 decades	14	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

								Comment	
5	Public safety risk assessment	0	1	2	3	4	Y	N	Assessed by GHD, 2016
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	Walling will require upgrading for 2050 risk.
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.

Assign to 'defer and monitor' and/or 'further investigation'.

Refer for further analysis and/or action (see next page).

### Explanation (if required)

	Monitor with specific focus on soft cliff under
X	esplanade road which could come under wave
	attack if seas rise as projected.

## Port Noarlunga

### Options Analysis (First Pass)

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

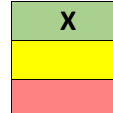
Evaluate		No risk	Low	Medium	High	Very high	Score		Comment
1	Inherent Erosion	0	2	4	6	8		5	
	Inherent Inundation	0	2	4	6	8		0	
2	Public assets (2020)	0	1	2	3	4		1	
	Public assets (2100)	0	1	2	3	4		4	Existing foreshore structures inadequate if SLR occurs.
3	Private assets (2020)	0	1	2	3	4		0	
	Private assets (2100)	0	1	2	3	4		3	Shops, SLSC (protection unlikely adequate)
4	Decades until likely impact (reverse order)	0	2	4	6	8		4	
		5 decades	4 decades	3 decades	2 decades	1 decades		17	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.
Do any of the following change the options outlook?									
5	Public safety risk assessment	0	1	2	3	4	Y	N	
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	Risk subject to sea level rise (see 2 above)
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

#### Recommendation

Assign to 'general monitoring' with no current issues.

Assign to 'defer and monitor' and/or 'further investigation'.

Refer for further analysis and/or action (see next page).



## Cell 4.1

### Foreshore Area

#### Explanation (if required)

The existing foreshore structures are adequate, but if seas rise as projected, these may need to be updated (but should be decades away).

## Port Noarlunga

### Options Analysis (First Pass)

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	5	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	1	
	Public assets (2100)	0	1	2	3	4	4	The Esplanade Road (limited protection)
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	2	Access to private property (if esplanade lost)
4	Decades until likely impact (reverse order)	0	2	4	6	8	4	
		5 decades	4 decades	3 decades	2 decades	1 decades	16	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

#### Do any of the following change the options outlook?

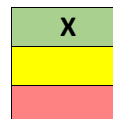
								Comment	
5	Public safety risk assessment	0	1	2	3	4	Y	N	
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	Potential for sand blow outs (Caton 2009)
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	Risk subject to sea level rise (see 2 above)
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

#### Recommendation

Assign to 'general monitoring' with no current issues.

Assign to 'defer and monitor' and/or 'further investigation'.

Refer for further analysis and/or action (see next page).



#### Explanation (if required)


## Cell 4.2

### The Esplanade

## Port Noarlunga

## Cell 4.3a

### Options Analysis (First Pass)

### Southport Beach

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	5	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	1	
	Public assets (2100)	0	1	2	3	4	1	
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	3	
4	Decades until likely impact (reverse order)	0	2	4	6	8	4	
		5 decades	4 decades	3 decades	2 decades	1 decades	<b>14</b>	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

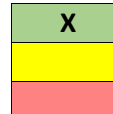
								Comment	
5	Public safety risk assessment	0	1	2	3	4	Y	N	
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	Potential for sand blow outs (Caton 2009)
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.

Assign to 'defer and monitor' and/or 'further investigation'.

Refer for further analysis and/or action (see next page).



### Explanation (if required)


## Port Noarlunga

### Options Analysis (First Pass)

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score	
1	Inherent Erosion	0	2	4	6	8	7	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	2	
	Public assets (2100)	0	1	2	3	4	3	
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	0	
4	Decades until likely impact (reverse order)	0	2	4	6	8	6	
		5 decades	4 decades	3 decades	2 decades	1 decades	18	

Comment
Erosion observed at base of cliffs. Groundwater impacts the cliffs (and potentially stability).

GHD identified high risk of landslides.
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Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.
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#### Do any of the following change the options outlook?

5	Public safety risk assessment	0	1	2	3	4	Y	N
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N
7	Are there any storm water issues that should be considered						Y	N
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N
9	Are there any stakeholder interests that would indicate further investigation?						Y	N
10	Are there any other factors that suggest further investigation required?						Y	N

Comment
Due to landslide risk (GHD, 2016)
Ongoing potential for slumps, slides.

#### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).

X

#### Explanation (if required)

Recommend further investigation of condition of cliffs to determine whether further action is required.

## Cell 4.3b

### Footbridge to River Mouth



## Port Noarlunga

### Options Analysis (First Pass)

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score
1	Inherent Erosion	0	2	4	6	8	4
	Inherent Inundation	0	2	4	6	8	6
2	Public assets (2020)	0	1	2	3	4	1
	Public assets (2100)	0	1	2	3	4	4
3	Private assets (2020)	0	1	2	3	4	0
	Private assets (2100)	0	1	2	3	4	3
4	Decades until likely impact (reverse order)	0	2	4	6	8	4
		5 decades	4 decades	3 decades	2 decades	1 decades	22

#### Comment

Estimated for options analysis.

Current levees inadequate if seas rise as projected.

Current levees inadequate if seas rise as projected.

Likely 4 decades until serious (but some risk earlier)

Score 18 or less - assign to general monitoring.  
Score 19 to 20 - consider further evaluation below.  
Score above 20 - further evaluation required.

#### Do any of the following change the options outlook?

5	Public safety risk assessment	0	1	2	3	4	Y	N
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N
7	Are there any storm water issues that should be considered						Y	N
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N
9	Are there any stakeholder interests that would indicate further investigation?						Y	N
10	Are there any other factors that suggest further investigation required?						Y	N

#### Comment

Low depth flood levels, low velocity, short duration.
Floodwaters will flow into new areas.
Long term - stormwater flows/ seawater confluence
Adequacy of levee heights - but subject to SLR.
Town businesses and residents.
Flood flow possible to River Road ?

#### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).

X
X

#### Explanation (if required)

Further investigation required to current flood flows
to River Road, adequacy of levee heights.
See also next page regarding Saltfleet Street.

## Port Noarlunga

## Cell 4.4

### Options Analysis (Second Pass)

### Port Noarlunga Township

This purpose of this worksheet is to analyse cells (or minor cells) that have been assessed as likely requiring adaptation action now or in the near future (5 years). The suitability of broad adaptation options are considered first, these being, managed retreat, hold the line, accommodate, loss acceptance (also known as 'do nothing'). Within these options are responses for consideration such as planning, engineered, environmental, or community responses.

#### 1 Identify previous adaptation actions. Why are additional actions likely to be required?

The event of 9 May 2016 overtopped Saltfleet Street from the west and flowed through Jubilee Park. Adaptation work will be required to prevent larger sea storm events (likely larger than 1 in 20 year events) from repeating this inundation pattern. The flooding risk will increase if seas rise as projected. Design for protection works to meet future sea level rise projections is included within the Wearing Street re-development project. Raising the existing banks and levees around Jubilee Park would manage sea level rise risk to ~2050 – 2060, subject to detailed assessments and investigation.

#### 2 Identify possible options

Hold the line (engineering or environmental)

Unlikely

☐

Possible

☐

Likely

☒

#### Justify or explain the response

Install protection to western side of street, and upgrade banks and levees.

Managed retreat (move assets/services away from coast)

☒☐☐

Not applicable as Saltfleet Street is a main access point to Port Noarlunga.

Accommodate (make minor adjustments, accept some risk)

☐☒☐

Allow flooding to occur intermittently. Close road, and clean up after the event.

Loss acceptance (do nothing)

☒☐☐

Not acceptable - public road, tourist route, main access to town.

#### 3 Taking into account the preferred option(s) consider responses

Planning

☒☐☐

Not applicable for road and public reserve.

Engineering

☐☐☒

Install protection to west, upgrade levees and banks on perimeter of park.

Environmental

☒☐☐

Not a suitable environment.

#### 4 Could the community make a contribution?

☒☐☐

The responses are likely to be engineered.

#### 5 Should a transformative approach be considered?

☐☒☐

The road is a main access point across the river and to the town.

#### 6 Conclusion (2nd Pass)

The most likely response will be to install protection to the western side of Saltfleet Creek so that water is unable to overtop the road. This may take the form of concrete walling (plinth) or earthen bund. Earthen bunds surround most of Jubilee Reserve. These could be raised where required, and the slope of the bank increased immediately to the east of the bridge.

## Seaford Cliffs

## Cell 5.1

### Options Analysis (First Pass)

### Exmouth Rd to Cliff Ave

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	4	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	1	
	Public assets (2100)	0	1	2	3	4	2	
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	0	
4	Decades until likely impact (reverse order)	0	2	4	6	8	2	
		5 decades	4 decades	3 decades	2 decades	1 decades	9	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

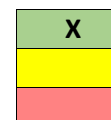
								Comment	
5	Public safety risk assessment	0	1	2	3	4	Y	N	Refer to GHD, 2016 (mixed assessment)
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	(This assessment rates public safety as 'low')
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.

Assign to 'defer and monitor' and/or 'further investigation'.

Refer for further analysis and/or action (see next page).



### Explanation (if required)


## Seaford Cliffs

## Cell 5.2

### Options Analysis (First Pass)

### Cliff Ave to Seaford Road

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score	Comment	
1	Inherent Erosion	0	2	4	6	8	7		
	Inherent Inundation	0	2	4	6	8	0		
2	Public assets (2020)	0	1	2	3	4	2		
	Public assets (2100)	0	1	2	3	4	4		
3	Private assets (2020)	0	1	2	3	4	0		
	Private assets (2100)	0	1	2	3	4	0		
4	Decades until likely impact (reverse order)	0	2	4	6	8	6		
		5 decades	4 decades	3 decades	2 decades	1 decades	19	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.	

Do any of the following change the options outlook?										Comment				
5	Public safety risk assessment	0		1		2		3		4		Y	N	Assessed by GHD, 2016 Possible sediment impact to reef.
6	Ecosystem disruption risk assessment	0		1		2		3		4		Y	N	
7	Are there any storm water issues that should be considered											Y	N	If seas rise as projected, sea level rise will impact cliff stability and infrastructure adjacent cliff top.
8	Should any of the above allocations to 'very high' influence the assessment?											Y	N	
9	Are there any stakeholder interests that would indicate further investigation?											Y	N	
10	Are there any other factors that suggest further investigation required?											Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.

Assign to 'defer and monitor' and/or 'further investigation'.

Refer for further analysis and/or action (see next page).

### Explanation (if required)

	Monitor cliff base and cliff crests in locations where
X	infrastructure is placed within close proximity to
	cliff crest.

## Adaptation Options Analysis

Seaford Cliffs

Cell 5.3

### 3. Options Analysis (First Pass)

(Seaford Rd to Robertson Rd)

This worksheet automatically populates from the risk assessment and a numerical value attached to each concept. Scores above the range of 18-21 will require further review, or scores in any particular category in the 'very high' range. Issues such as public safety and ecosystem disruption are dealt with in separate processes.

Assign a Score		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	7	Proximity of assets to top of cliff.
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	2	
	Public assets (2100)	0	1	2	3	4	4	
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	2	
4	Decades until likely impact (reverse order)	0	2	4	6	8	6	
		5 decades	4 decades	3 decades	2 decades	1 decades	21	Score 18 or less - defer and monitor. Score 19 to 20 - consider further evaluation. Score above 20 - further evaluation required.

#### Assess additional factors

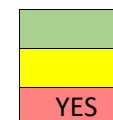
5	Public safety risk assessment	0	1	2	3	4	Y	N	Assessed by GHD, 2016
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	Unknown impact to reef with sediment runoff.
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

#### Recommendation

Assign to 'defer and monitor' with no current issues.

Assign to 'defer and monitor' with one or two minor issues.

Refer for further analysis and/or action.



#### Comment


# Seaford Cliffs

## Cell 5.3a

### Options Analysis (Second Pass)

#### Gulf St to Helmsman Tce

This purpose of this worksheet is to analyse cells (or minor cells) that have been assessed as likely requiring adaptation action now or in the near future (5 years). The suitability of broad adaptation options are considered first, these being, managed retreat, hold the line, accommodate, loss acceptance (also known as 'do nothing'). Within these options are responses for consideration such as planning, engineered, environmental, or community responses.

#### 1 Identify previous adaptation actions. Why are additional actions likely to be required?

This section of road reserve is positioned adjacent the cliff crest (1-3m). Ongoing scarping and slumps have required 25m of 'contiguous piling' to stabilise the cliff south of Gulf Street. Ongoing weathering will continue to cause instability in the upper cliff face, and sea level rises at the base will add to this instability. Council is considering reinforced concrete path to bridge erodible parts of the cliff.

#### 2 Identify possible options

Hold the line (engineering or environmental)

Managed retreat (move assets/services away from coast)

Accommodate (make minor adjustments, accept some risk)

Loss acceptance (do nothing)

Unlikely  
Possible  
Likely

#### Justify or explain the response

Council considering reinforced concrete path to bridge eroding area.

Consider shared use zone, divert half traffic, retreat road infrastructure.

No obvious ways accommodation can be utilised.

Not acceptable - public road, tourist route, services housing.

#### 3 Taking into account the preferred option(s) consider responses

Planning

Engineering

Environmental

The area is coastal reserve, public road. Housing set well back behind esplanade rd.

Possible, with newly proposed reinforced concrete path, rather than piling.

Not possible - wave attack at the base.

#### 4 Could the community make a contribution?

Unlikely - unless reporting on new slumps and slides.

#### 5 Should a transformative approach be considered?

Creating a shared-use zone was considered with diversion of one way traffic. The cost would be prohibitive, and political problems created with traffic diversion.

#### 6 Conclusion (2nd Pass)

Council is considering an alternative protection strategy to inserting pylons (retaining wall) under the carpark. The strategy to be considered is to construct a reinforced footpath to span the eroding area. An incremental approach would be employed to install rock protection to the base of the cliff as required. In the context of relatively low rates of sea level rise, this approach is likely to be the option of choice.

# Seaford Cliffs

## Cell 5.3b

### Options Analysis (Second Pass)

#### Helmsman to Robertson

This purpose of this worksheet is to analyse cells (or minor cells) that have been assessed as likely requiring adaptation action now or in the near future (5 years). The suitability of broad adaptation options are considered first, these being, managed retreat, hold the line, accommodate, loss acceptance (also known as 'do nothing'). Within these options are responses for consideration such as planning, engineered, environmental, or community responses.

#### 1 Identify previous adaptation actions. Why are additional actions likely to be required?

Vegetation has been maintained at the crest and stormwater controlled so that it is piped to the base of the cliffs. The carpark at Tiller Drive is about to be 'retreated' and the walking trail diverted away from one additional cliff scarp (see plans). Additional actions are likely to be required due to the vertical nature of cliffs in 5.3. Any increases in sea level rise (even slow) will continue to erode the base of the cliffs causing instability, slumping and potential collapse.

#### 2 Identify possible options

Hold the line (engineering or environmental)

Managed retreat (move assets/services away from coast)

Accommodate (make minor adjustments, accept some risk)

Loss acceptance (do nothing)

Unlikely	Possible	Likely	Justify or explain the response
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Rock revetment/sand bags (1.1kms) but this does not halt upper cliff instability.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Tiller carpark about to be retreated. Walking trail could be all retreated.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No obvious ways accommodation can be utilised.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not acceptable - risk to trail and public safety with potential cliff collapses.

#### 3 Taking into account the preferred option(s) consider responses

Planning

Engineering

Environmental

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	The area is coastal reserve, public road. Housing set well back behind esplanade rd.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Unlikely to be feasible due to cost.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not possible due to wave interaction with base of cliff.

#### 4 Could the community make a contribution?

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Unlikely. Unless informing Council of slumps/ slides/ storm impact.
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#### 5 Should a transformative approach be considered?

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	An alternative layout for the walking trail could be master planned and installed over coming decade - move walking trail away from top of cliff / allow to recede.
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#### 6 Conclusion (2nd Pass)

A hold the line at the base of the cliff is unlikely to be viable (due to cost).. The most likely option is to retreat the walking trail. The downside will be loss of views with the walking trail positioned at lower elevation. Recommend a master plan for the walking trail be created that could be progressively installed over time.



## Moana Beach

## Cell 6.1

### Options Analysis (First Pass)

### Foreshore area

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	6	
	Inherent Inundation	0	2	4	6	8	4	
2	Public assets (2020)	0	1	2	3	4	1	
	Public assets (2100)	0	1	2	3	4	4	Erosion and inundation
3	Private assets (2020)	0	1	2	3	4	2	Erosion and inundation (post 2050)
	Private assets (2100)	0	1	2	3	4	4	SLSC, restaurant (subject to inundation 2100).
4	Decades until likely impact (reverse order)	0	2	4	6	8	6	
		5 decades	4 decades	3 decades	2 decades	1 decades	27	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

								Comment	
5	Public safety risk assessment	0	1	2	3	4	Y	N	Not from erosion, possible inundation risk (waves)
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	Urbanised backshore.
7	Are there any storm water issues that should be considered						Y	N	Alternative end control for end of Fourth Ave?
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	Erosion and inundation - long term outlook.
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	Prominent foreshore area, also SLSC.
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).

### Explanation (if required)

	Any upgrades to the foreshore region should consider
	long term outlook if seas rise as projected. In particular
X	SLSC vulnerable in larger storms.

# Moana Beach

## Cell 6.1

### Options Analysis (Second Pass)

#### Foreshore Region

This purpose of this worksheet is to analyse cells (or minor cells) that have been assessed as likely requiring adaptation action now or in the near future (5 years). The suitability of broad adaptation options are considered first, these being, managed retreat, hold the line, accommodate, loss acceptance (also known as 'do nothing'). Within these options are responses for consideration such as planning, engineered, environmental, or community responses.

#### 1 Identify previous adaptation actions. Why are additional actions likely to be required?

Previous actions include sand bag controls at base of upper carpark. Cement rock seawall across entire foreshore area (including to south side of onramp). Seawall appears to have a 'tilt' on the northern end. Dunes installed and/or consolidated in front of Moana SLSC and southern carpark. SLSC suffered wave impact/debris in event of 9 May 2016. Storm water crosses the road in 'flood' in rain events and scours beach (without end control). Sand levels frequently drop adjacent the wall.

#### 2 Identify possible options

Hold the line (engineering or environmental)

Managed retreat (move assets/services away from coast)

Accommodate (make minor adjustments, accept some risk)

Loss acceptance (do nothing)

Unlikely	Possible	Likely
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

#### Justify or explain the response

Change configuration SLSC beach access. Install dune adjacent wall or other control.

Reconfigure foreshore layout to provide greater buffer (dunes). Problem - SLSC.

Allow storms to occasionally impact infrastr. Increase SLSC resilience/cleanup up.

Not acceptable - public foreshore area.

#### 3 Taking into account the preferred option(s) consider responses

Planning

Engineering

Environmental

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

The area is a public reserve and crown land.

Seawall is a viable response unless seas rise as projected (2050+)

Consolidate dunes in front of SLSC. Attempt dune adjacent north end of seawall?

#### 4 Could the community make a contribution?

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Beach monitoring (storms). Dune maintenance (possible).

#### 5 Should a transformative approach be considered?

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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Possible to envision pedestrian precinct, close off two roads. Or reduce to one lane?

Not evaluated within the workshop process.

#### 6 Conclusion (2nd Pass)

Consider developing a new master plan for Moana Beach and install a more flexible coast (sand dunes, remove seawall) However, the current location of the SLSC probably means that realigning the coast is unwarranted (i.e. removing seawall). The area behind could be raised and made into a pedestrian precinct. Ongoing creation and management of sand dune forward of the seawall will provide a storage of beach sand and increased protection from sea impacts.

## Moana Beach

## Cell 6.2

### Options Analysis (First Pass)

### Pedler Creek

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score		Comment
1	Inherent Erosion	0	2	4	6	8	6		
	Inherent Inundation	0	2	4	6	8	4		
2	Public assets (2020)	0	1	2	3	4	1		
	Public assets (2100)	0	1	2	3	4	3		
3	Private assets (2020)	0	1	2	3	4	0		
	Private assets (2100)	0	1	2	3	4	2		
4	Decades until likely impact (reverse order)	0	2	4	6	8	4		
		5 decades	4 decades	3 decades	2 decades	1 decades	20		Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

										Comment
5	Public safety risk assessment	0	1	2	3	4	Y	N		Seawater likely to be contained within creek channel
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N		Seawater likely to be contained within creek channel
7	Are there any storm water issues that should be considered						Y	N		Seawater flowed up storm water pipes to Nashwauk.
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N		(on 9 May 2016, but minimal flow)
9	Are there any stakeholder interests that would indicate further investigation?						Y	N		Tourist park, but threat unlikely to be immediate.
10	Are there any other factors that suggest further investigation required?						Y	N		

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).

### Explanation (if required)

X	Investigate bank and levee heights to ensure adequacy and seawater intrusion into storm water pipes.

## Moana Beach

## Cell 6.3

### Options Analysis (First Pass)

### Moana Sands Conservation Park

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score		Comment
1	Inherent Erosion	0	2	4	6	8	6		
	Inherent Inundation	0	2	4	6	8	0		
2	Public assets (2020)	0	1	2	3	4	0		
	Public assets (2100)	0	1	2	3	4	0		
3	Private assets (2020)	0	1	2	3	4	0		
	Private assets (2100)	0	1	2	3	4	0		
4	Decades until likely impact (reverse order)	0	2	4	6	8	4		
		5 decades	4 decades	3 decades	2 decades	1 decades	10		Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

5	Public safety risk assessment	0	1	2	3	4	Y	N	
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).

X

### Explanation (if required)


## Moana Beach

### Options Analysis (First Pass)

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score		Comment
1	Inherent Erosion	0	2	4	6	8	6		
	Inherent Inundation	0	2	4	6	8	0		
2	Public assets (2020)	0	1	2	3	4	1		
	Public assets (2100)	0	1	2	3	4	1		
3	Private assets (2020)	0	1	2	3	4	0		
	Private assets (2100)	0	1	2	3	4	0		
4	Decades until likely impact (reverse order)	0	2	4	6	8	4		
		5 decades	4 decades	3 decades	2 decades	1 decades	12		Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

#### Do any of the following change the options outlook?

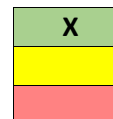
5	Public safety risk assessment	0	1	2	3	4	Y	N	
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

#### Recommendation

Assign to 'general monitoring' with no current issues.

Assign to 'defer and monitor' and/or 'further investigation'.

Refer for further analysis and/or action (see next page).



#### Explanation (if required)


## Cell 6.4

### Moana Heights

## Ochre Point

### Options Analysis (First Pass)

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

## Cell 7.0

### Ochre Point

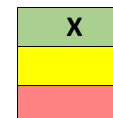
Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	5	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	0	
	Public assets (2100)	0	1	2	3	4	0	
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	0	
4	Decades until likely impact (reverse order)	0	2	4	6	8	4	
		5 decades	4 decades	3 decades	2 decades	1 decades	9	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

#### Do any of the following change the options outlook?

5	Public safety risk assessment	0	1	2	3	4	Y	N	
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	Interest as Kaurna site.
10	Are there any other factors that suggest further investigation required?						Y	N	

#### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).



#### Explanation (if required)


## Maslin Beach - North

## Cell 8.1

### Options Analysis (First Pass)

### Maslin - North of Maslin Creek

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score		Comment
1	Inherent Erosion	0	2	4	6	8	4		
	Inherent Inundation	0	2	4	6	8	0		
2	Public assets (2020)	0	1	2	3	4	1		
	Public assets (2100)	0	1	2	3	4	2		
3	Private assets (2020)	0	1	2	3	4	0		
	Private assets (2100)	0	1	2	3	4	0		
4	Decades until likely impact (reverse order)	0	2	4	6	8	6		Decreased to 2 decades due to previous mine.
		5 decades	4 decades	3 decades	2 decades	1 decades	13		Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

5	Public safety risk assessment	0	1	2	3	4	Y	N	
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	Previous sand mine - possible sediment release to sea.
7	Are there any storm water issues that should be considered						Y	N	Sand mine managed by State Government. Council is
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	monitoring ocean impacts as part of its advocacy for the
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	State to rehabilitate and protect the land.
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).

### Explanation (if required)

X	Monitor ocean impacts on former sand mine (see above)
X	See next page



## Maslin Beach - North

## Cell 8.1

### Options Analysis (Second Pass)

### Maslin Beach Carpark

This purpose of this worksheet is to analyse cells (or minor cells) that have been assessed as likely requiring adaptation action now or in the near future (5 years). The suitability of broad adaptation options are considered first, these being, managed retreat, hold the line, accommodate, loss acceptance (also known as 'do nothing'). Within these options are responses for consideration such as planning, engineered, environmental, or community responses.

#### 1 Identify previous adaptation actions. Why are additional actions likely to be required?

A carpark has been installed in the 1980s adjacent Maslin Creek which suffers from sand drift. Larger storms take significant 'bites' out of the sand dunes in front of the carpark. If seas rise as projected in the future, then these sand dunes may erode away and the carpark left vulnerable to wave attack.

#### 2 Identify possible options

Hold the line (engineering or environmental)

Managed retreat (move assets/services away from coast)

Accommodate (make minor adjustments, accept some risk)

Loss acceptance (do nothing)

Unlikely	Possible	Likely	Justify or explain the response
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Dune stability (Planting). Eventually, rock protection (if seas rise as projected).
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	When useable life is diminished, consider removing three or more banks of parks.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Manage sand drift periodically.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not acceptable - public carpark.

#### 3 Taking into account the preferred option(s) consider responses

Planning

Engineering

Environmental

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	The area is a public reserve and crown land.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Seawall is possible in the long term, but not desirable.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Dune consolidation will reduce recession (currently maintained by council)

#### 4 Could the community make a contribution?

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Beach monitoring (storms). Dune maintenance (possible).
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#### 5 Should a transformative approach be considered?

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not relevant in this location. Carpark can be maintained, even if reduced size.
-------------------------------------	--------------------------	--------------------------	---

#### 6 Conclusion (2nd Pass)

The carpark is not under immediate threat from actions of the sea but would be if seas rose as projected post 2050. The carpark is subject to sand drift which requires constant maintenance by Council. When the asset life of the carpark has diminished, consideration could be given to reducing the size of the carpark by 3 banks, or more. In other words, close off the carpark adjacent the beach and return to dunes.

## Maslin Beach - South

## Cell 8.2

### Options Analysis (First Pass)

### Maslin - South of Maslin Creek

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	4	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	1	Beach access point - Maslin south.
	Public assets (2100)	0	1	2	3	4	2	
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	0	
4	Decades until likely impact (reverse order)	0	2	4	6	8	6	
		5 decades	4 decades	3 decades	2 decades	1 decades	13	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

								Comment	
5	Public safety risk assessment	0	1	2	3	4	Y	N	Assessed by GHD 2016 - risk of slides, falls, slumps.
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).

### Explanation (if required)

X	Review fencing on upper track.
	Public safety requires ongoing effort with signage etc.

## Port Willunga - North

## Cell 9.1

### Options Analysis (First Pass)

### North of Willunga Creek

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

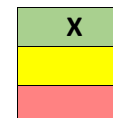
Evaluate		No risk	Low	Medium	High	Very high	Score		Comment
1	Inherent Erosion	0	2	4	6	8	5		
	Inherent Inundation	0	2	4	6	8	0		
2	Public assets (2020)	0	1	2	3	4	1		Beach access point - Maslin south.
	Public assets (2100)	0	1	2	3	4	1		
3	Private assets (2020)	0	1	2	3	4	0		
	Private assets (2100)	0	1	2	3	4	0		
4	Decades until likely impact (reverse order)	0	2	4	6	8	2		
		5 decades	4 decades	3 decades	2 decades	1 decades	9		Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

										Comment
5	Public safety risk assessment	0	1	2	3	4	Y	N		Assessed by GHD 2016 (low pedestrian area)
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N		
7	Are there any storm water issues that should be considered						Y	N		
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N		
9	Are there any stakeholder interests that would indicate further investigation?						Y	N		
10	Are there any other factors that suggest further investigation required?						Y	N		

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).



### Explanation (if required)


## Port Willunga - Creek

## Cell 9.2

### Options Analysis (First Pass)

### Willunga Creek

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

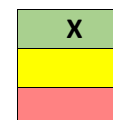
Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	5	
	Inherent Inundation	0	2	4	6	8	2	
2	Public assets (2020)	0	1	2	3	4	1	Beach access point.
	Public assets (2100)	0	1	2	3	4	2	Beach access point.
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	0	
4	Decades until likely impact (reverse order)	0	2	4	6	8	4	
		5 decades	4 decades	3 decades	2 decades	1 decades	<b>14</b>	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

								Comment	
5	Public safety risk assessment	0	1	2	3	4	Y	N	
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	Kaurna interest adjacent beach access point (but not
10	Are there any other factors that suggest further investigation required?						Y	N	under threat currently).

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).



### Explanation (if required)


## Port Willunga - South

## Cell 9.3

### Options Analysis (First Pass)

### South of Willunga Creek

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

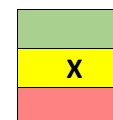
Evaluate		No risk	Low	Medium	High	Very high	Score		Comment
1	Inherent Erosion	0	2	4	6	8		4	Limestone cliffs, relatively resistant to erosion but subject to falls and slumps.
	Inherent Inundation	0	2	4	6	8		0	
2	Public assets (2020)	0	1	2	3	4		1	Beach access point - Maslin south.
	Public assets (2100)	0	1	2	3	4		3	
3	Private assets (2020)	0	1	2	3	4		1	Star of Greece restaurant
	Private assets (2100)	0	1	2	3	4		3	
4	Decades until likely impact (reverse order)	0	2	4	6	8		4	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.
		5 decades	4 decades	3 decades	2 decades	1 decades		16	

### Do any of the following change the options outlook?

5	Public safety risk assessment	0	1	2	3	4	Y	N	Assessed by GHD 2016 - public safety risk.
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	Star of Greece position atop cliff.
10	Are there any other factors that suggest further investigation required?						Y	N	Gully under Star of Greece assessed as stable.

### Recommendation

Assign to 'general monitoring' with no current issues.  
 Assign to 'defer and monitor' and/or 'further investigation'.  
 Refer for further analysis and/or action (see next page).



### Explanation (if required)

Monitor cliffs for slumps, slides and falls.

## Aldinga Reef

## Cell 10.1

### Options Analysis (First Pass)

Marlin Rd to Chenoweth St

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

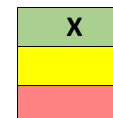
Evaluate		No risk	Low	Medium	High	Very high	Score		Comment
1	Inherent Erosion	0	2	4	6	8	5		
	Inherent Inundation	0	2	4	6	8	0		
2	Public assets (2020)	0	1	2	3	4	0		
	Public assets (2100)	0	1	2	3	4	2		
3	Private assets (2020)	0	1	2	3	4	0		
	Private assets (2100)	0	1	2	3	4	0		
4	Decades until likely impact (reverse order)	0	2	4	6	8	4		
		5 decades	4 decades	3 decades	2 decades	1 decades	11		Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

5	Public safety risk assessment	0	1	2	3	4	Y	N	Assessed by GHD, 2016
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).



### Explanation (if required)


## Aldinga Reef

## Cell 10.2

### Options Analysis (First Pass)

### Chenoweth to Aldinga Beach Rd

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	7	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	3	
	Public assets (2100)	0	1	2	3	4	4	
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	3	Assumes no intervention to protect road.
4	Decades until likely impact (reverse order)	0	2	4	6	8	8	
		5 decades	4 decades	3 decades	2 decades	1 decades	25	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

Do any of the following change the options outlook?										Comment
5	Public safety risk assessment	0	1	2	3	4	Y	N		Assessed by GHD, 2016. Low pedestrian area.
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N		Future risk of sediment into the sea (reef risk)
7	Are there any storm water issues that should be considered						Y	N		
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N		Current risk to infrastructure (larger storms/ sea level)
9	Are there any stakeholder interests that would indicate further investigation?						Y	N		
10	Are there any other factors that suggest further investigation required?						Y	N		

### Recommendation

Assign to 'general monitoring' with no current issues.

Assign to 'defer and monitor' and/or 'further investigation'.

Refer for further analysis and/or action (see next page).

### Explanation (if required)

	Council has completed options analysis prior to this
	project and developed preliminary plans for rock
X	levee/bund to be positioned parallel to the shoreline.

# Aldinga Reef

## Cell 10.2

### Options Analysis (Second Pass)

#### Chenoweth to Aldinga Beach Rd

This purpose of this worksheet is to analyse cells (or minor cells) that have been assessed as likely requiring adaptation action now or in the near future (5 years). The suitability of broad adaptation options are considered first, these being, managed retreat, hold the line, accommodate, loss acceptance (also known as 'do nothing'). Within these options are responses for consideration such as planning, engineered, environmental, or community responses.

#### 1 Identify previous adaptation actions. Why are additional actions likely to be required?

Studies: 2001,2005,2007, 2011, 2016. Installation of ground water inception trench (Gordon Street), 2002. Reports that slumps decreased with less moisture in the cliff face. In 2015, 29 piles inserted in the back of the cliff with lengths 14m, 600mm diameter, placed 100mm apart. Revegetation programs. Warning Signage. Scenario modelling using inputs from CES indicate in a 1 in 100-year event, the very friable clay cliff would be seriously impacted. 9 May 2016 removed the base.

#### 2 Identify possible options

Hold the line (engineering or environmental)

Managed retreat (move assets/services away from coast)

Accommodate (make minor adjustments, accept some risk)

Loss acceptance (do nothing)

Unlikely	Possible	Likely
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

#### Justify or explain the response

Rock revetment (bund) at base of cliff, or offset from the cliff.

Retreat half the road (one way), divert traffic to Croser Road. Increase buffer +6m

No obvious way that accommodate can be utilised.

Not acceptable - public road.

#### 3 Taking into account the preferred option(s) consider responses

Planning

Engineering

Environmental

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The area is a public reserve and crown land.

Seawall is most likely option.

Any attempt at the base would be quickly removed. Continue vegetation at crest.

#### 4 Could the community make a contribution?

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
-------------------------------------	--------------------------	--------------------------

Unlikely community could make any ongoing contribution.

#### 5 Should a transformative approach be considered?

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
-------------------------------------	--------------------------	--------------------------

Unlikely - narrow road reserve. A retreat strategy only achieves +6m unless private dwellings purchased. Not viable.

#### 6 Conclusion (2nd Pass)

The risk assessment and scenario modelling indicates that adaptation action will be required in this location. The likely response will be a hard engineering response to the base of the cliff, or offset from the cliff. The latter may be preferable so that it can be installed at a lower height and act as a buffer against actions of the sea, rather than attempting to protect a very friable cliff with higher levels of protection required. Council has plans drawn for this option (supported).



## Aldinga Reef

## Cell 10.3

### Options Analysis (First Pass)

### Aldinga Beach Rd to Ocean St

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

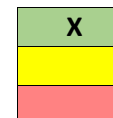
Evaluate		No risk	Low	Medium	High	Very high	Score	Comment
1	Inherent Erosion	0	2	4	6	8	7	
	Inherent Inundation	0	2	4	6	8	0	
2	Public assets (2020)	0	1	2	3	4	1	
	Public assets (2100)	0	1	2	3	4	3	
3	Private assets (2020)	0	1	2	3	4	0	
	Private assets (2100)	0	1	2	3	4	1	
4	Decades until likely impact (reverse order)	0	2	4	6	8	4	
		5 decades	4 decades	3 decades	2 decades	1 decades	16	Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

								Comment	
5	Public safety risk assessment	0	1	2	3	4	Y	N	
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	Possible long term - sediment to the sea ?
7	Are there any storm water issues that should be considered						Y	N	
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).



### Explanation (if required)


## Aldinga Beach

## Cell 11.1

### Options Analysis (First Pass)

### Lower Esplanade Road

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score		Comment
1	Inherent Erosion	0	2	4	6	8	5		Wave impacts sometimes interact with the backshore.
	Inherent Inundation	0	2	4	6	8	0		
2	Public assets (2020)	0	1	2	3	4	2		
	Public assets (2100)	0	1	2	3	4	4		
3	Private assets (2020)	0	1	2	3	4	0		
	Private assets (2100)	0	1	2	3	4	3		
4	Decades until likely impact (reverse order)	0	2	4	6	8	4		Larger erosion recession in this minor cell.
		5 decades	4 decades	3 decades	2 decades	1 decades	18		Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

5	Public safety risk assessment	0	1	2	3	4	Y	N	
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	Drain outlet at Quondong considered for upgrade.
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	Potential impact on Lower Esplanade Road.
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).

### Explanation (if required)

	Potential for higher rate of beach recession exists that could impact Lower Esplanade Road.
X	

# Aldinga Beach

## Cell 11.1

### Options Analysis (Second Pass)

#### Lower Esplanade Road

This purpose of this worksheet is to analyse cells (or minor cells) that have been assessed as likely requiring adaptation action now or in the near future (5 years). The suitability of broad adaptation options are considered first, these being, managed retreat, hold the line, accommodate, loss acceptance (also known as 'do nothing'). Within these options are responses for consideration such as planning, engineered, environmental, or community responses.

#### 1 Identify previous adaptation actions. Why are additional actions likely to be required?

Storm of 2007 impacted backshore, toilet removed (p. 7). No adaptation strategies employed. The question as to the need of adaptation strategies relates to whether a low cost adaptation option can be employed now that may protect the road in the longer term. However, slower rates of sea level rise should be considered. Council advises that sand drift fencing to be installed adjacent onramp (160m in four lengths 25m to 30m each).

#### 2 Identify possible options

Hold the line (engineering or environmental)

Managed retreat (move assets/services away from coast)

Accommodate (make minor adjustments, accept some risk)

Loss acceptance (do nothing)

Unlikely	Possible	Likely
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

#### Justify or explain the response

Sand nourishment, dune vegetation and stabilisation.

Not possible. No access further inland. Significant services in road. Access needs.

No obvious ways accommodation can be utilised.

Not acceptable - public road, tourist route, services housing.

#### 3 Taking into account the preferred option(s) consider responses

Planning

Engineering

Environmental

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

The area is a public reserve and crown land. Housing set behind road.

Possible but not advisable. Hard engineering not required at this stage.

Sand nourish, build dune, vegetate. Risk, wave runup removes before established.

#### 4 Could the community make a contribution?

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Beach monitoring (storms). Dune maintenance (possible).

#### 5 Should a transformative approach be considered?

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Not relevant in this location.

#### 6 Conclusion (2nd Pass)

Consider 'hold the line' using environmental management. Current larger storms remove the vegetation at the base of the road escarpment. Any increases in sea level (even at slower rate) is likely to impact the base of the embankment under Lower Esplanade Road. Historically, it does not appear of any dune system existed in this location (since the installation of the dirt track). Council advises that four lengths of drift fencing to be installed adjacent onramp which will act as trial.

## Aldinga Beach

## Cell 11.2

### Options Analysis (First Pass)

### Wattle Ave to Loongana Road

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score		Comment
1	Inherent Erosion	0	2	4	6	8	5		
	Inherent Inundation	0	2	4	6	8	2		
2	Public assets (2020)	0	1	2	3	4	1		
	Public assets (2100)	0	1	2	3	4	2		
3	Private assets (2020)	0	1	2	3	4	0		
	Private assets (2100)	0	1	2	3	4	1		
4	Decades until likely impact (reverse order)	0	2	4	6	8	4		
		5 decades	4 decades	3 decades	2 decades	1 decades	15		Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

										Comment
5	Public safety risk assessment	0	1	2	3	4	Y	N		
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N		Loss of sand dunes - longer term (post 2050)
7	Are there any storm water issues that should be considered						Y	N		Outlet adjacent onramp (becomes filled with debris).
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N		
9	Are there any stakeholder interests that would indicate further investigation?						Y	N		
10	Are there any other factors that suggest further investigation required?						Y	N		

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).

X

### Explanation (if required)

Review storm water outlet adjacent onramp.

## Aldinga Beach

## Cell 11.3

### Options Analysis (First Pass)

### Washpool Region

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score		Comment
1	Inherent Erosion	0	2	4	6	8	7		Low lying area behind the pebble bank.
	Inherent Inundation	0	2	4	6	8	5		
2	Public assets (2020)	0	1	2	3	4	0		
	Public assets (2100)	0	1	2	3	4	3		
3	Private assets (2020)	0	1	2	3	4	0		
	Private assets (2100)	0	1	2	3	4	3		
4	Decades until likely impact (reverse order)	0	2	4	6	8	2		
		5 decades	4 decades	3 decades	2 decades	1 decades	20		Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

										Comment
5	Public safety risk assessment	0	1	2	3	4	Y	N		
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N		Seawater may flow into freshwater ecology (post 2070)
7	Are there any storm water issues that should be considered						Y	N		Confirm separate stormwater and freshwater system
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N		
9	Are there any stakeholder interests that would indicate further investigation?						Y	N		Kaurna Interest.
10	Are there any other factors that suggest further investigation required?						Y	N		How the pebble bank will react to sea level rise.

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).

### Explanation (if required)

	Impact of sea level rise likely to be 50 years away.
X	How the pebble bank might react could be investigated.
	Confirm separate stormwater/ freshwater systems.

## Sellicks Beach

## Cell 12.0

### Options Analysis (First Pass)

### Sellicks Beach

The first pass assessment uses the outputs from the risk assessment (1-3), takes into account the likely time before impact (4), and investigates various other parameters (5-10). Three assignments are possible. The first is a general monitoring category where no current or future significant issues are identified. The second assigns to 'defer and monitor' where a future issue is recognised if seas rise as projected, and/or to 'further investigation'. The third category requires further adaptation options analysis which is included on the following page.

Evaluate		No risk	Low	Medium	High	Very high	Score		Comment
1	Inherent Erosion	0	2	4	6	8	5		Soft erodible cliffs.
	Inherent Inundation	0	2	4	6	8	0		
2	Public assets (2020)	0	1	2	3	4	1		
	Public assets (2100)	0	1	2	3	4	3		
3	Private assets (2020)	0	1	2	3	4	0		
	Private assets (2100)	0	1	2	3	4	1		
4	Decades until likely impact (reverse order)	0	2	4	6	8	4		
		5 decades	4 decades	3 decades	2 decades	1 decades	14		Score 18 or less - assign to general monitoring. Score 19 to 20 - consider further evaluation below. Score above 20 - further evaluation required.

### Do any of the following change the options outlook?

5	Public safety risk assessment	0	1	2	3	4	Y	N	Assessed by GHD, 2016
6	Ecosystem disruption risk assessment	0	1	2	3	4	Y	N	
7	Are there any storm water issues that should be considered						Y	N	Not from urban environments. Natural rain storms will
8	Should any of the above allocations to 'very high' influence the assessment?						Y	N	continue to gully the cliff environments.
9	Are there any stakeholder interests that would indicate further investigation?						Y	N	
10	Are there any other factors that suggest further investigation required?						Y	N	

### Recommendation

Assign to 'general monitoring' with no current issues.  
Assign to 'defer and monitor' and/or 'further investigation'.  
Refer for further analysis and/or action (see next page).

### Explanation (if required)

X	Minor works proposed for lower carpark