Wattle Range
COUNCIL

Rivoli Bay Summary Report

Understanding coastal processes in our region

Introduction

Located on the Limestone Coast in South Australia, Rivoli Bay is home to the townships of Southend and Beachport.

The impacts of coastal processes are visible in and around both townships. Historically these impacts have been managed with coastal infrastructure such as groyne fields and seawalls, and a range of management activities such as sand carting.

Wattle Range Council (Council) has invested in a number of coastal studies in the past which provided high level recommendations to address the coastal management issues at both Southend and Beachport and to reduce siltation issues at the Beachport Boat Ramp. Through these studies Council has engaged with the communities from both towns and has a range of management options for consideration.

To build on this knowledge and test the merit of these management options, Council partnered with the Coast Protection Board to undertake a detailed data collection and modelling study for Rivoli Bay. Coastal consultants, Baird Pty Ltd (Baird) were engaged to:

- Collect local metocean data (water levels, waves and currents) to confirm the coastal processes within Rivoli Bay
- Develop a scientific base model of coastal processes of Rivoli Bay using the collected data
- Use the developed scientific model to forecast the success of management options to:
    - Reduce the impacts of coastal processes on the town beaches of Beachport and Southend
    - Reduce siltation at the Beachport Boat Ramp, and
    - Consider Glenn Point as an alternate location of the Beachport Boat Ramp

This summary report shares the key findings and has been compiled to help community understand the approach, the identified management options, recommendations and actionable next steps.

A full description of the analysis, including data collected and scientific models, can be found in the technical report, Rivoli Bay Data Collection and Modelling.

Beachport Foreshore

COASTAL PROCESSES

Key focus of investigation: reduce the impacts of coastal processes on the town beaches of Beachport

The technical study confirmed the following specific to Beachport foreshore:

Sand is moving along the beach in a net northward direction, primarily driven by waves during storms.

Typical seasonal patterns are observed. During storm events sand is eroded from the shore and transported offshore. It gradually returns to the shore by waves during calmer weather. As a result, beaches are typically wider over summer and erode in winter.

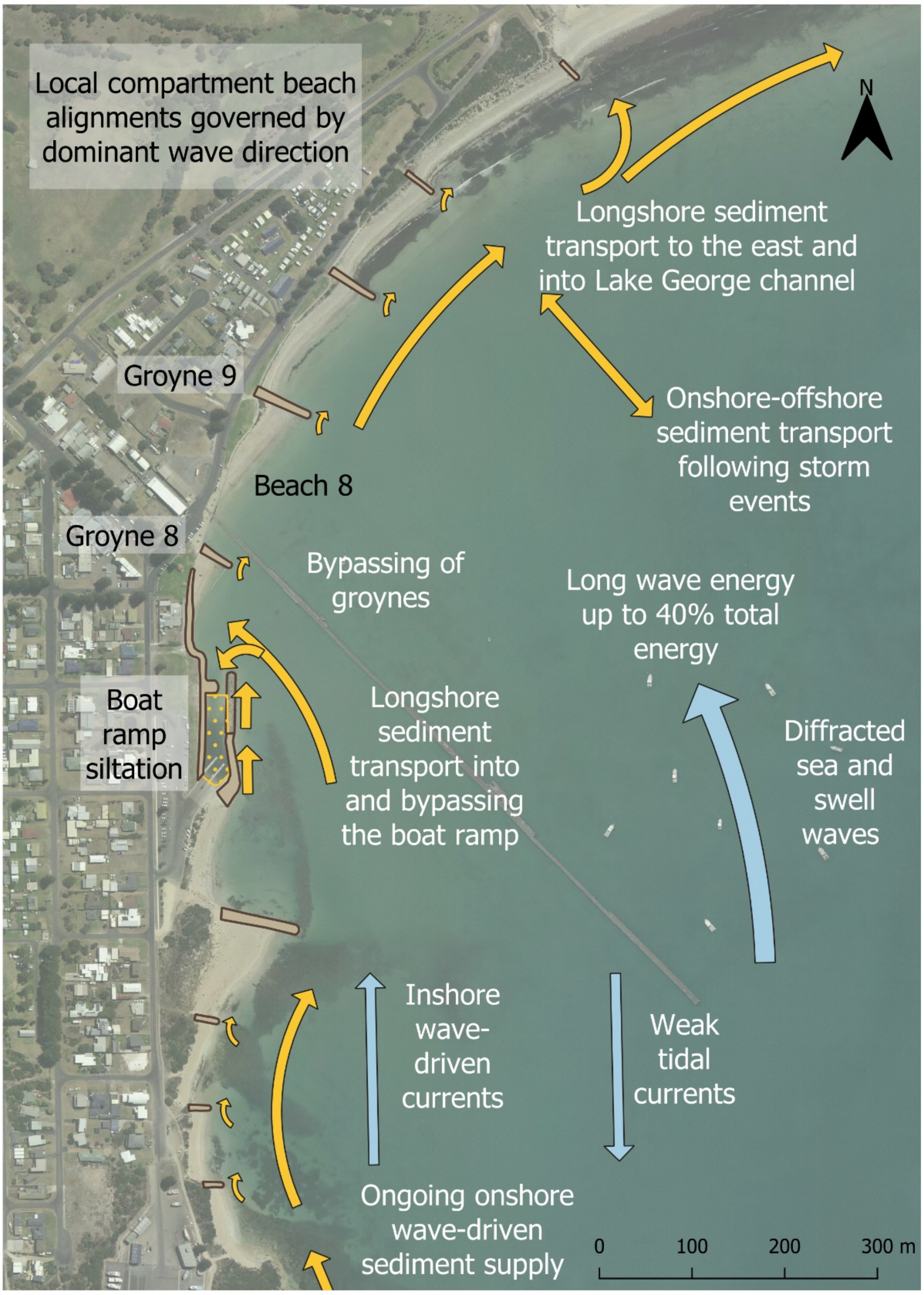
Nearshore currents vary at Beachport, with stronger currents travelling northward along the shoreline driven by waves. These currents are strong enough to drive northwards sand movement.

Further offshore, weak currents travel southward driven by the tidal circulation within Rivoli Bay. These currents are not strong enough to move sand.

The width of beaches along the Beachport foreshore is influenced by the shape and dimension of the groynes and their alignment with incoming waves.

Beaches between the groynes (beach compartments) are generally 'full' or at capacity indicating there is sufficient sand in the system and the groynes are actively trapping, and then, bypassing sand.

An exception is that little to no beach exists at the beach compartment directly north of the Beachport Jetty **(referred to as Beach 8, shown in Figure 1)**. This is due to the length and positioning of Groynes 8 and 9 **(shown in Figure 1)** and is further amplified by the vertical wall adjacent to the jetty reflecting incoming waves and moving sand offshore.



Legend

Imagery: DEW February 2019

- Sediment Transport
- Waves and currents
- Shoreline
- Coastal Structures

Figure 1: *Conceptual model of coastal processes for Beachport foreshore*

MANAGEMENT OPTIONS

The technical study established that beaches along the Beachport foreshore are 'full' or at capacity except for Beach 8, where the groynes to either side of Beach 8 (Groynes 8 and 9) are incorrectly positioned to maintain a wide beach, and that alterations to the existing structures are required.

Four options were identified and assessed to improve the width of Beach 8, three of which could be tested in modelling **(shown in Figure 2)**:

- **Option B1** – Addition of a groyne in Beach 8, between Groynes 8 and 9
- **Option B2** – Changes to Groyne 8:
  - a) Reorientation north
  - b) Extension of Groyne 8
- **Option B3** – Extension of Groyne 9

An additional option (Option B4), was considered for the Beachport foreshore more broadly, to modify the existing groynes by reducing their height and removing the landward connection. With the intended purpose to improve sand movement between beach compartments.

Technical note
Whilst Option B4 could not be modelled, engineering judgment and analysis was used to consider its effectiveness **(an example is shown in Figure 3)**

***Figure 2:** Beachport foreshore management options*

The detailed assessment **(shown in Table 1)** indicated several options would slightly increase the width of Beach 8.

Table 1: *Detailed assessment of management options for Beachport foreshore*

OPTION		OUTCOME OF DETAILED ASSESSMENT
B1 Additional groyne (between Groynes 8 and 9)	✓	A minimum 50m long groyne at the centre of Beach 8 is needed to maintain a stable beach Initial sand nourishment would be required to create the beach
B2a Reorientation of Groyne 8	✗	By itself, reorienting the existing groyne is not enough to maintain a beach
B2b Extension of Groyne 8	✓	A 45m extension to the existing Groyne 8 could maintain a beach
B3 Extension of Groyne 9	✓	A 20m extension of existing Groyne 9 could maintain a beach

Additional information Further detail on the assessment is in the Technical Report (Baird 2021, Section 5.6)

Figure 3: *An example of what lowering existing groynes (Option B4) would look like*

RECOMMENDATIONS + NEXT STEPS

A combination of B1 and B2 (known as an optimised option), were deemed to deliver the best results. The optimised option **(shown in Figure 4)** involves:

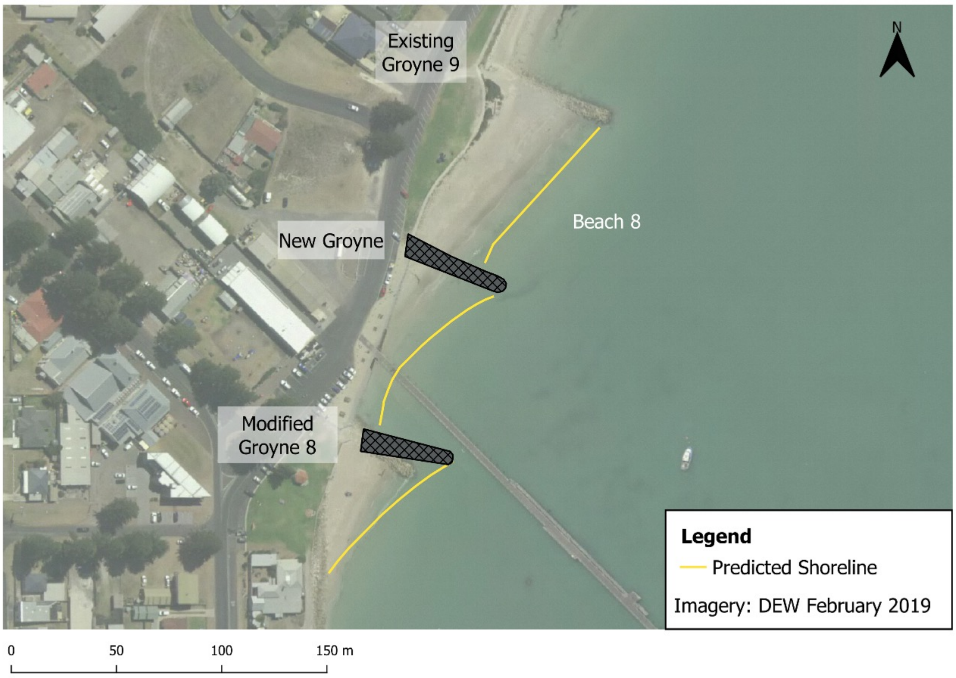
Extending Groyne 8 to a total of 44m in length

Rotating the seaward end of Groyne 8 north by 20°

Constructing a new 38m long groyne in the centre of Beach 8

Undertaking sand nourishment to fill the new beach

Option B4 is considered to have merit for groynes south of the Beachport Boat Ramp.Implementation of this option could be undertaken as a trial initially on the two southern groynes.



Additional information
Further information is described in the Technical Report (Baird 2021, Section 5.6.5)

Figure 4: *Recommended option for Beachport foreshore including extension and rotation of Groyne 8 and a new groyne in the centre of Beach 8 (Baird 2021)*

NEXT STEPS

The below next steps are recommended, prior to proceeding to detailed design, to ensure the management approach is economically viable and will deliver long-term value to our community:

1. Assess recommendations alongside Beachport Boat Ramp management options to ensure any potential changes are complimentary and support an integrated approach.
2. Quantify capital and ongoing maintenance costs, including initial sand nourishment requirements.
3. Present benefits and constraints for Council consideration and community consultation.
4. If validated, progress to detailed engineering design of recommended option.
5. If constructed, develop plan for ongoing monitoring of shoreline.

Southend Foreshore

COASTAL PROCESSES

Key focus of investigation: reducing the rate of shoreline recession and increasing beach widths along the foreshore east of Lake Frome Outlet

The technical study confirmed the following specific to the Southend foreshore (outlined in Figure 5):

The dominant coastal process at Southend is waves driving sand transport in shallow water (between 0m Mean Sea Level (MSL) and -3m MSL) and along the shore to the east.

Typical seasonal patterns are observed. During storm events sand is eroded from the shore and transported offshore. It gradually returns to the shore by waves during calmer weather. As a result, beaches are typically wider over summer and erode in winter.

Longshore sand transport increases towards the eastern end of Southend where shorelines are more exposed to waves. The sand transport rates are also higher during the winter months.

The groyne on the west side of the Lake Frome outlet is effective at capturing sand moving east and as a result the beach west of the Lake Frome outlet is stable.

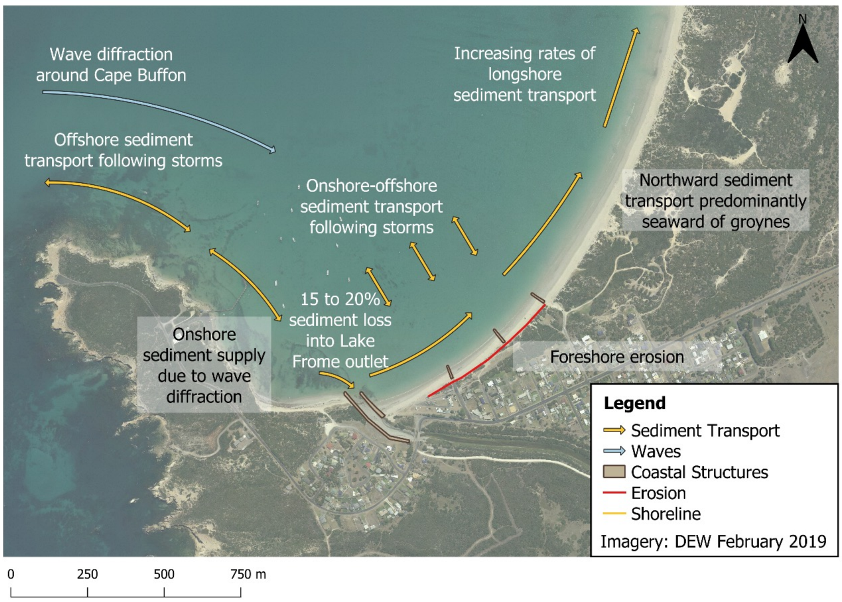
The Lake Frome outlet drain traps approximately 15% to 20% of sand moving east along the coast.

Seagrass loss in the nearshore coastal environment has increased the exposure of the shoreline to waves and contributed to coastal erosion.

Beaches east of the Lake Frome outlet are eroding, with those east of the groyne field eroding at the fastest rate.

The three groynes east of the Lake Frome outlet have not been effective at trapping longshore sand transport. A significant portion of longshore sand transport occurs beyond the end of the existing groyne structures.

Figure 5: Conceptual model of coastal processes for Southend foreshore



MANAGEMENT OPTIONS

A range of management options were identified to reduce sand trapping at the Lake Frome outlet, reduce erosion in front of the Caravan Park and improve the sand trapping capacity of the existing groynes, east of the Lake Frome outlet. Six options were screened in a first pass assessment **(as shown in Table 2)** with base modelling completed for the three identified as most effective.

Table 2: *First pass assessment of management options for Southend (Baird 2021)*

MANAGEMENT OPTION	PURPOSE	OUTCOME OF FIRST PASS ASSESSMENT	
Option S1 Remove Lake Frome outlet groynes	Reduce trapping potential of the Lake Frome outlet	✗	This will allow greater sand movement to the east but may cause western beach to erode, impacting amenity.
Option S2 Remove Lake Frome outlet eastern groyne	Reduce trapping potential of the Lake Frome outlet	✓	This option may balance dual objectives of maintaining western beach while increasing eastward sand transport.
Option S3a Offshore breakwater fronting Caravan Park	Shelter the coast from waves, reduce sand transport	✓	A 200m long breakwater 300m offshore of the Caravan Park may promote sand accretion.
Option S3b Submerged offshore breakwater Caravan Park	Shelter the coast from waves, reduce sand transport	✗	Very similar to option S3a. Could be explored further if Option 3a is successful. May have good environmental and visual amenity.
Option S4a Lengthening the three eastern groynes	Capture more longshore sand transport, reduce sand transport	✓	Desktop calculations indicate extending all three groynes by 30m to 45m could trap more sand and improve shoreline stability.
Option S4b Additional groyne and repositioning existing groynes	Capture more longshore sand transport, reduce sand transport	✗	Additional groyne structures may reduce beach amenity and will be costly.

Three options were progressed for detailed assessment **(shown in Figure 6)**. As for Beachport foreshore, an additional option to modify existing groynes to improve sand movement between beach compartments, by reducing their height and removing the landward connection, was also considered **(Figure 3)**.

Additional information
Further detail on the options assessed and first pass assessment can be found within Section 6.5 of the Technical Report (Baird 2021)

Figure 6: *Modelled management options for Southend (modified from Baird 2021)*

Table 3: *Detailed assessment of management options for Southend (after Baird 2021)*

MANAGEMENT OPTION	OUTCOME OF DETAILED ASSESSMENT	
Option S2 Removal of Lake Frome outlet eastern groyne	✓	The removal of the eastern outlet groyne reduces the capacity of the outlet to trap sand, increasing sand availability to the beach in front of the caravan park.
Option S3a Offshore breakwater in front of Caravan Park	✗	An offshore breakwater will have a significant influence and will lead to sand accretion in front of the caravan park but increase erosion significantly to beaches further east.
Option S4a Lengthening the three eastern groynes	✓	Groyne extension is very effective at increasing sand build-up between the eastern groynes combating the ongoing erosion trend and increasing the sand buffer for storm events. There may be increased erosion east of the groyne field
Lowering Existing Groynes	✓	Lowering the crest level of the three eastern groynes would improve sand movement along the shoreline, visual and user amenity.

Additional information
Section 6.6 of the Technical Report (Baird, 2021) provides further detail on the assessment of options using the Base Model

RECOMMENDATIONS + NEXT STEPS

Multiple options, implemented concurrently, are required to stabilise the shoreline east of the Lake Frome outlet groynes and increase beach widths. The recommended option **(shown in Figure 7)** involves:

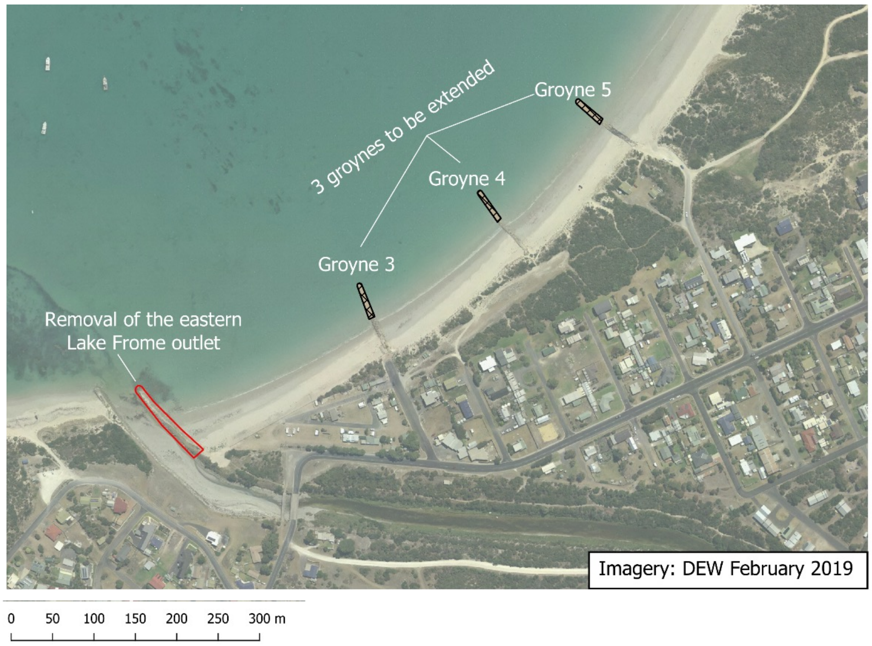
Retention of the western Lake Frome outlet groyne.

Removal of the eastern Lake Frome outlet groyne. This is expected to boost sand supply to the east.

Extension of the three eastern groynes (Groyne 3 by 30m, Groyne 4 by 25m and Groyne 5 by 25m) to increase sand trapping efficiency and widen the beach.

Lowering the crest height of the three eastern groynes. If rock is in suitable condition and of a suitable size it could be beneficially reused to extend the groynes.

Consideration of beach nourishment during construction to widen the beach faster and reduce the likelihood of downdrift erosion east of the groyne field.



Additional information
Further information is described in the Technical Report (Baird 2021, Section 6.7 and 6,8)

Figure 7: *Final recommended option for Southend shoreline (Baird 2021)*

NEXT STEPS

The below next steps are recommended, prior to proceeding to detailed design, to ensure the management approach is economically viable and will deliver long-term value to our community:

1. Quantify the volume of reuse rock from the removal of the eastern Lake Frome outlet eastern groyne and lowering of the eastern groynes and investigate suitable construction methods.
2. Quantify capital and ongoing maintenance costs, including initial sand nourishment requirements needs.
3. Present benefits and constraints against other adaptation pathways for Council consideration and community consultation.
4. If validated, undertake detailed design to optimise the length of the extended groynes with consideration of sand trapping efficiency and cost.
5. If constructed, develop plan for ongoing monitoring of shoreline.

Beachport Boat Ramp

COASTAL PROCESSES

Key focus of investigation: determine process driving siltation at boat ramp and identify management options

The investigation at the Beachport Boat Ramp concluded that:

Significant long wave energy is present in Beachport.

The long wave energy enters the boat ramp basin, becomes trapped and then magnified. This generates currents that travel in and out of the boat ramp basin every 2 to 3 minutes.

Northward's wave driven currents along the shore are also one of the key coastal processes in Beachport.

These currents drive the northwards transport of sand along the shore, and along the ocean side of the boat ramp breakwater.

These currents are strong enough to stir up sand, and transport this to the entrance of the boat ramp basin in a plume of sand laden water.

The long wave driven currents transport the plume of suspended sand from the entrance into the basin, these currents are also strong enough to transport sand from the seabed into the basin.

The volume of sand transported into the basin increases during high tides.

The sand transported into the basin settles out of the water the calmer conditions, becoming trapped in the basin.

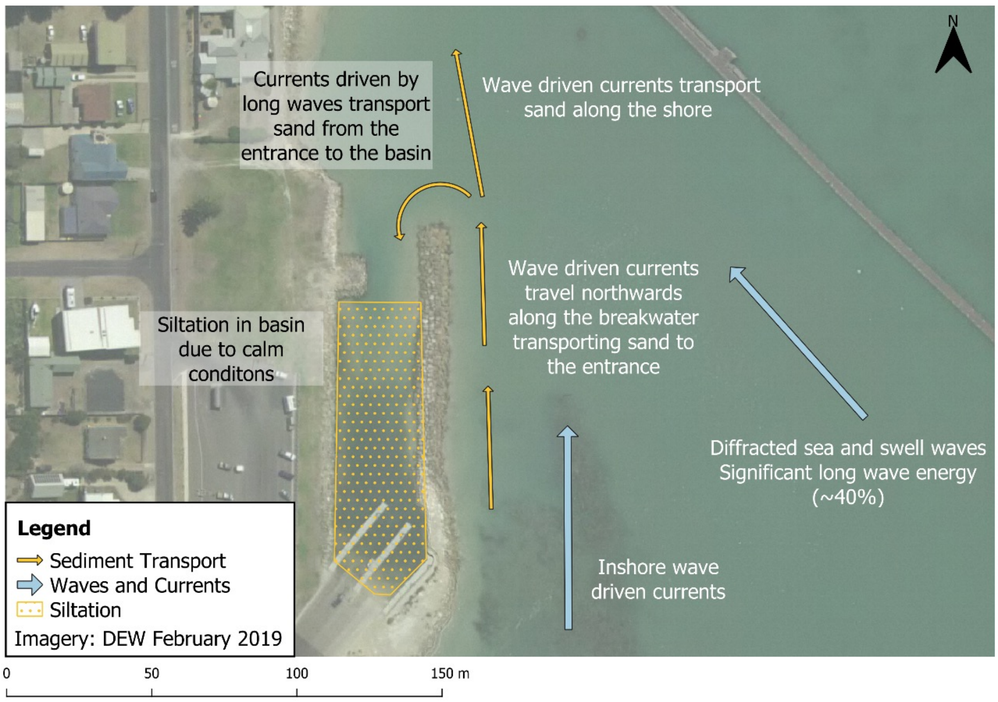


Figure 8: *Key siltation processes at Beachport Boat Ramp (Baird 2021)*

MANAGEMENT OPTIONS

Potential management options to reduce siltation at Beachport Boat Ramp were identified from concepts raised in community discussion, previous studies, and the assessment of key coastal processes in the technical study. Nine options to reduce siltation were screened in a first pass assessment **(shown in Table 4)** with base modelling completed for the three identified as most effective.

Table 4: *First pass screening of management options for reducing siltation at Beachport Boat Ramp (Baird, 2021)*

MANAGEMENT OPTION	PURPOSE	OUTCOME OF FIRST PASS ASSESSMENT	
Option BR1a Narrow the boat ramp basin	Reduce long wave energy and/or the sand pathway into the basin	✗	Changing the width will not reduce long wave driven currents
Option BR1b Narrow the basin entrance width	Reduce long wave energy and/or the sand pathway into the basin	✗	May inadvertently increase siltation by increasing long wave currents through the entrance
Option BR2a Add perpendicular groyne to the breakwater	Intercept and trap northerly longshore transport	✗	Will build up sand next to breakwater, trapped sand may impact seagrass beds
Option BR2b Added deflection structure	Deflect northbound sand transport away from the entrance	✓	May successfully guide sand laden currents away from the entrance
Option BR3a Rebuild submerged offshore breakwater	Reduce alongshore current speeds and sand laden currents along the breakwater	✗	Likely to create a disturbance to sensitive seagrass communities
Option BR3b Offshore Breakwater	Reduce alongshore current speeds and sand laden currents along the breakwater	✓	Nearshore depths are suitable, further investigation recommended
Option BR4a Create an opening/s along the breakwater	Breakdown long wave energy in the basin	✗	Opening would also allow sand to enter the basin
Option BR4b Breakwater shortening	Breakdown long wave energy in the basin	✓	This may reduce long wave energy, reducing sand transport into the basin
Option BR5 Review sand management practices	Improve management of secondary causes of sand accumulation i.e., "sand blowing over the breakwater"	~	Will not address the primary causes of siltation however a desktop review of sand management practices is recommended

Additional information
Further detail on the first pass assessment is in Section 7.3 of the Technical Report (Baird 2021)

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BEACHPORT BOAT RAMP

Three options **(shown in Figure 9)** were progressed to detailed assessment using the base model **(shown in Table 5)**.

Table 5: *Detailed assessment of management options for reducing siltation at Beachport Boat Ramp (Baird, 2021)*

MANAGEMENT OPTION		OUTCOME OF DETAILED ASSESSMENT
Option BR2b Added deflection structure	✓	The model results indicate a 95% reduction in siltation when a 25m long nib is added to the breakwater. Different deflection structure lengths were assessed confirming a 25m long nib would lead to the greatest reduction in siltation.
Option BR3b Offshore Breakwater	✗	The model results indicate an offshore breakwater could reduce siltation by up to 75%, however this was not the most effective option. A submerged offshore breakwater was also modelled as an alternative but was less effective.
Option BR4b Breakwater shortening	✗	Models indicated shortening the breakwater by approximately half would likely increase siltation within the boat ramp basin.

Additional information
Further information on the detailed assessment of options can be found in Section 7.4 of the Technical Report (Baird 2021)

Figure 9: *Modelled management options for Beachport Boat Ramp*

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RECOMMENDATIONS + FUTURE STEPS

The assessment found the addition of a 25m long deflection structure to the existing boat ramp breakwater **(Option BR2b shown in Figure 9)** could reduce siltation at Beachport Boat Ramp by up to 95%. The additional deflection structure guides sand laden currents away from the boat ramp entrance, removing the main source of siltation in the basin.

Management options for the Boat Ramp have been assessed purely on the technical information produced by a scientific model. This analysis determined the most effective approach to reducing sand in the Boat Ramp Basin. However social, safety and environmental factors still need to be considered. Council is not proposing to further investigate the management options at this time, as any additional structures would require the closure of Beachport's main swimming beach, relocation of the swimming pontoon and boats to travel through this well utilised area to avoid the new nib or offshore breakwater.

Council will continue with dredging the Boat Ramp Basin and further investigate the recommended options for the Beachport and Southend Foreshore areas.

FUTURE STEPS

Should the community wish for Council to proceed with further investigation of the management options discussed in the Rivoli Bay Data Collection & Modelling Report, the below next steps are recommended to ensure the management approach is fit-for-purpose, economically viable and will deliver long-term value to our community:

1. Further design deflection structure including detailed modelling to optimise the length of deflection structure, quantify the reduction in boat ramp siltation and determine the fate of the deflected sand.
2. Quantify impact when combined with recommended management options for the Beachport foreshore to ensure an integrated approach.
3. Quantify capital and ongoing costs and consider alongside existing sand management practises.
4. Present benefits and constraints for Council consideration and community consultation.
5. Review sand management practices for the beaches adjacent to the boat ramp to reduce any potential secondary sources of siltation to the boat ramp.

Alternative boat ramp location at Glenn Point

Based on community feedback the feasibility of upgrading boat launching facilities at Glenn Point **(shown in Figure 10)** was assessed within the technical study.

Analysis of the coastal processes and modelling indicated Glenn Point is not an appropriate location for a boat launching facility for the following reasons:

While Penguin Island provides some shelter, modelling showed wave conditions are regularly above the recommended criteria advised by Australian Standards. Without a breakwater structure for protection, a boat ramp at this location would require restricted launch windows to operate safely.

A detached breakwater would be the only viable protection structure to consider here, to avoid interrupting northerly sand transport to Beachport foreshore.

A detached breakwater at this location would need to be a substantial structure due to water depths and direction of incoming waves. Construction and ongoing maintenance costs of an offshore breakwater of this size would be substantial.

Whilst an offshore breakwater would create calmer conditions in the lee of the structure for most periods, a navigation safety hazard is of concern as vessels transiting into open water may be met with beam on conditions.

Modelling also confirmed a large eddy flow feature is generated in the lee of Penguin Island which is not considered suitable for a boat launching facility.

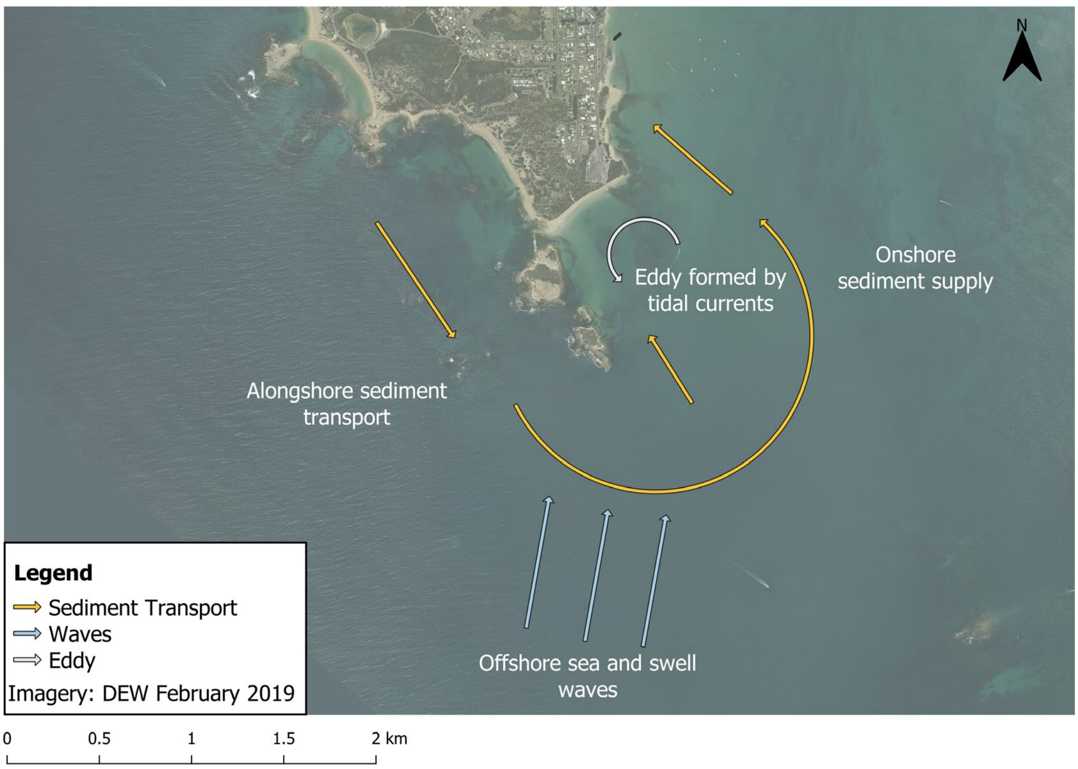

Figure 10: Glenn Point coastal processes

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